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Yakima River Spring Chinook Enhancement Study

Annual Report 1986

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Yakima River Spring Chinook Enhancement Study

Annual Report FY 1985

by

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Yakima Indian Nation

Fisheries Resource Management

Funded by

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2.0 ABSTRACT

The purpose of this project is to evaluate enhancement methodologies that can be used to rebuild runs of spring chinook salmon in the Yakima River basin. The study has the follwoing objectives;

1. Determine the abundance, distribution and survival of naturally produced fry and smolts in the Yakima River.
2. Evaluate different methods of fry and smkolt supplementation into the natural rearing environment while maintaining as much as possible the gentic integrity of naturally produced stocks.
3. Locate and define areas in the watershed which may be used for the rearing of spring chinook.
4. Define strategies for enhancing natural production of spring chinook in the Yakima River.
5. Determine physical and biological limitations for produciton within the system.

A total of six spring chinook redds were successfully capped in 1985. Survival to emergence was calculated as the total number of captured emergent fry divided by the estimated number of eggs deposited in each redd. The number of eggs deposited was calculated using a length fecundity model developed from females sampled during the spawning of the 1985 broodstock. The equation that best describes the length fecundity relationship was Y=16.51 (X) - 7947.3. The mean survival to emergence was 62.5% and ranged from 29.3% to 84.8%. The mean number of temperature units required for 50% and 100% emergence was 1,937 and 2,215 T.U.'s respectively. The survival from egg to smolt was calculated using the 1981, 1982 and 1983 redd counts and 1983, 1984 and 1985 smolt outmigration at Prosser. The estimated survival was 6.4%, 4.7% and 4.4% for 1981, 1982 and 1983 brood years for a mean egg to smolt survival over three years of 5.2%.

Monthly beach seining indicated a general downstream movement of fry soon after emergence in both the Yakima and Naches Rivers. Few fish reared in the lower river during the summer due to excessive temperatures.

The smolt outmigration was monitored at Wapatox on the Naches River and Prosser on the lower Yakima. The spring outmigration at Wapatox was estimated to be 41,511 smolts. A fall outmigration of 59,459 pre-smolts was estimated to pass wapatox in October and November.

A total of 242,207 salmonids were counted at Prosser in 1985. The total catch included 46,841 wild spring chinook, 29,912 hatchery spring chinook, 41,126 wild fall chinook, 33,299 wild steelhead, 18,615 hatchery steelhead and 70,449 hatchery coho. No salmonids were captured during August or September.

Total 1985 outmigration of wild spring chinook wild fall chinook and wild steelhead from the Yakima Basin was estimated at 82,567, 59,191, and 55,589, respectively. Comparable figures for 1984 are 119,520, 33,329 and 63,205, while those for 1983 are 135,548, 89,288 and 57,173. These estimates demonstrate that the outmigration of spring chinook has been declining, while the outmigration of steelhead has been relatively constant.

In 1985 a total of 3,783 adult and 423 jack spring chinook salmon returning to the Yakima River were counted at Prosser Fish ladder at RM 48. This gives a total of 4,206 salmon returning to Prosser Dam. The mean dates of passage were May 27 and June 4 for adults and jacks respectively. An additional 321 fish were estimated to have been caught in the Yakima River subsistence dipnet fishery below Horn Rapids and Prosser Dams. Therefore, total return to the Yakima system was 4,527 spring chinook salmon. This was the largest return of spring chinook salmon to the Yakima River in 19 years.

Spring chinook were counted at Roza Dam from May 13 to September 30, 1985. Passage at Roza Dam was 2,125 adult and 239 jack spring chinook for a total of 2,364 fish. A total of 97 adults were taken to he Lost Creek Brood Stock holding facility for use in the broodstock evaluations. An additional 544 fish were harvested between Prosser and Roza Dams in the subsistence dipnet fishery The mean dates of passage at Roza Dam were June 16 and June 29 for spring chinook adults and jacks respectively.

The smolt to adult (S_{sa}) survivalwas calculated based on teh 1983 smolt out-migration estimated at Prosser and the 1984 return of jacks (3 year old fish) and the 1985 return of four year old adults to the Yakima River. It was estimated that 3,572 wild three and four old fish returned from an estimated smolt out-migration of 135,548 fish in 1983. This gives an estimated survival from smolt to adult of 2.6%. This estimated rate of survival will increase with the addition of the five year old fish that will return in 1986.

This estimated rate of survival from smolt to adult is also subject to error due to our estimation of total out-migration. We are quite confident in the smolt out-migration estimation proceedure for Prosser. However, from the recent findings atwapatox Smolt trap indicating an extensive fall out-migration, and the preliminary findings on the Chandler Canal Entrainment Study indicating fish movemen in January and February there may be a large out-migration of pre-smolt spring chinook during the months when the Chandler CAnal Smolt trap is inoperable due to screen removal.

Hatchery groups being tested are (1) smolts trucked from Leavenworth N.F.H. and released directly into the river, (2) smolts released from acclimation ponds, (3) fingerlings released in June, September, and November, (4) wild broodstocks, (5) wild/hatchery hybrid broodstock.

Spring chinook adults from three different hatchery release groups were recovered in 1985. These fish were identified by the coded wire tags recovered in the Yakima Indian Nation zone 6 ceremonial and subsistance fishery, the Yakima River ceremonial dipnet fishery, and from spawning ground surveys and carcass recovery surveys conducted on the Yakima and Naches River systmes in Septembr and October of 1985. A total of 1,296 fish were inspected for adipose fins and coded wire tags in 1985.

The 1985 tag recoveries were from the 1982 release of 401,714 spring chinook smolts in the upper Yakima and the 1983 releases of 97,011 smolts in the upper Yakima and 99,725 smolts from the Nile springs acclimation pond. All tags recovered were expanded by the sample rate (fish sampled/total number of fish caught for a fishery or fish sampled/total number of spawners estimated in each river from spawner surveys) and by the mark rate or coded wire tag retention rate.

The reevoceries from the 1982 release group were returning as five year old fish and complete the data necessary to calculate the total survival (jacks, four-year fish, and five year fish) from smolt to adult for that release. In 1984 it was estimated that 219 spring chinook returned as four year old adults from the 1982 release group. When this is added to the estimated 57 fish that returned in1985 it gives a total of 276 adults returning from a release of 401,714 smolts. This gives a final smolt to adult survival rate of 0.069%.

The two 1983 release groups were from the Nile Spring acclimation pond and smolts trucked and released directly into the upper Yakima River. The total number of smolts released for each group was similar with 99,725 from Nile Springs pond and 97,011 from the upper Yakima. Nearly twice as many adults returned from the acclimation pond (59) as from the trucked release (31). Survival rates from smolt planting to returning adult for the acclimation pond and trucked fish are 0.06% and 0.03% respectively. Again, these survival rates will increase if any fish from these release groups return in 1986 as five year old adults.

3.0 INTRODUCTION

The population of Yakina River spring chinook salmon (**Oncorhynchus** t s hawy tsc ha) has been drastically reduced from historic levels reported to be as high as 250,000 (Smoker, 1956). This reduction is the result of a series of problems; mainstem Columbia dams, dams within the Yakima itself, severely reduced flows due to irrigation diversions, outmigrant loss in irrigation canals, increased thermal and sediment loading, and over fishing. Despite these problems, the escapement of spring chinook to the Yakima River has continued at levels ranging from 166 to 4,752 since 1957.

In October, 1982, the Bonneville Power Administration contracted the Yakima Indian Aation to develop methods to increase production of spring chinook in the Yakima System. The Yakima Nation's enhancement policy attempts to maintain as much as possible the genetic integrity of the spring chinook stock native to the Yakima Basin. Relatively small numbers of hatchery fish have been released into the basin in past years. Data from the Wenatchee System indicate a return rate from hatchery smolts of less than .25% (Mullan, 1982). Return rates from the current Yakima study smolt releases are .07%. These low return rates indicate that few fish would have returned from these early hatchery releases. With this information, it was decided that any fish introduced into the Yakima system would be coded wire tagged to evaluate the efficiency of various release methodologies and to distinguish the origin of returning adults.

The goal of this study is to develop data that will be used to present management alternatives for Yakima River Spring Chinook. The study has two objectives. The first objective is to determine the distribution, abundance and survival of wild Yakima River spring chinook. Naturally produced populations are being studied to determine if these runs can be sustained in the face of present harvest and environmental conditions. Survival through each life stage is being evaluated in an attempt to determine limitations to natural production in the basin. Survival to emergence studies are being conducted to determine survival through the incubation stage. Analysis of the relationship between redd survival and gravel substrate quality is being undertaken. Seining at selected sites and electroshocking surveys have beer. conducted to evaluate distribution and abundance of juvenile fish. Smolt outmigrations are monitored at the Wapatox juvenile trap on the Naches River and at the Prosser juvenile trap on the mainstem Yakima River. Aduit returns are determined by monitoring the Yakima Tribal dipnet fishery, counting adults at Prosser and Roza fish l adders, and through spawning ground surveys. Physical parameters such as water temperatures and stream flow are monitored throughout the basin.

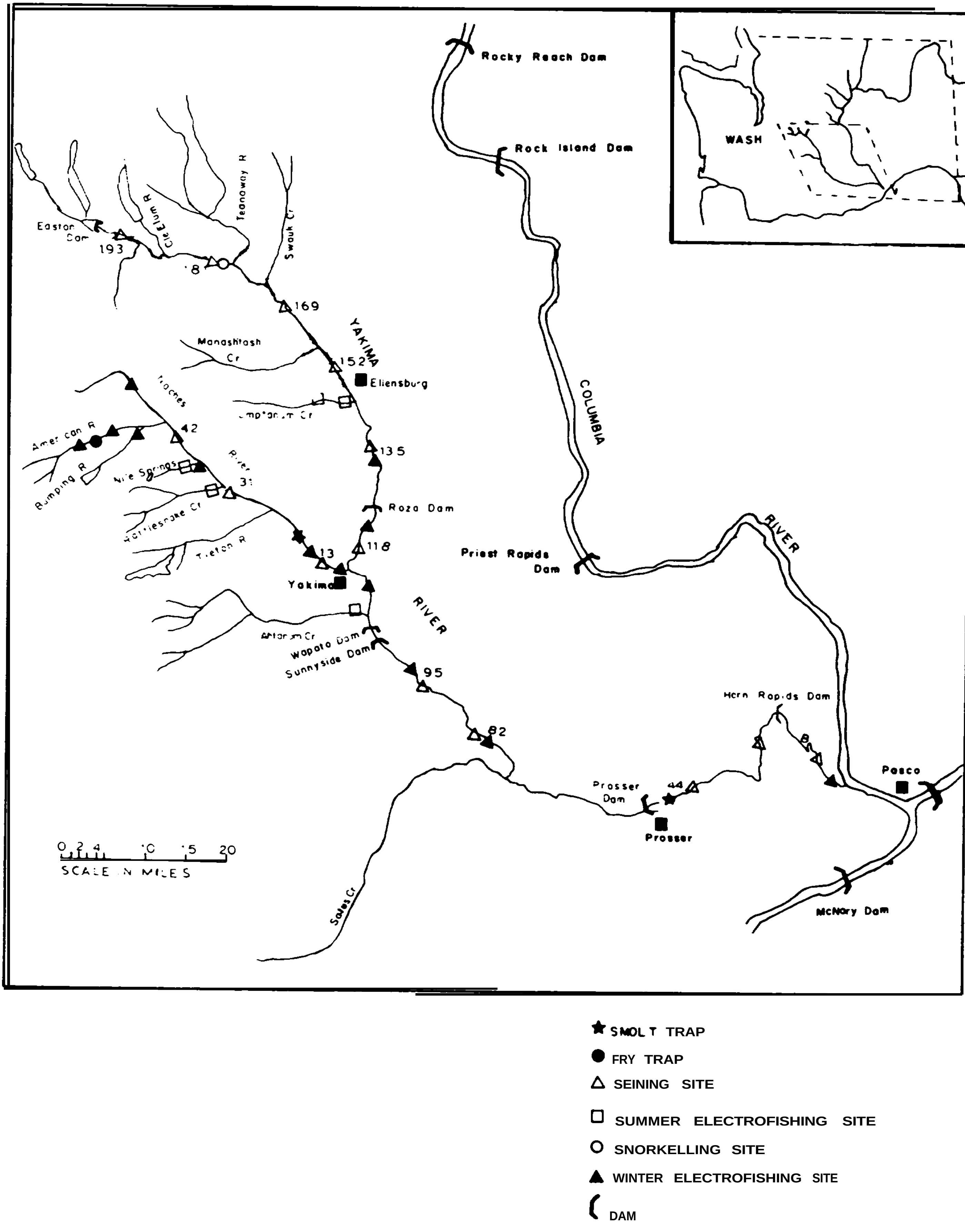
The second objective of this study is to determine relative effectiveness of different methods of hatchery supplementation. This analysis is divided into four segments. (1) When should fish be released? Smolt releases are the norm, but fingerl ings were released in June, September, and Novmeber, of 1984 and 1985. Downstream survival of these snolts will be evaluated and adult returns will be monitored. (2) Where should fish be released? Based on distribution studies, fish will be released in areas that minimize competitive interactions ith wild fisn. This will bc done by scatter planting fish so densities in the river will remain lowenough to minimize competition for food and space between hatchery and wild stocks. (3) How should fish be released? In the past, fish have either been transported from a hatchery and released into the Yakima River, or raised in rearing ponds. These methods, as well as tte use of acclimation ponds will be evaluated. (4) which stocks shold be released? Smolts will be released as hatchery x hatchery, hatchery X wild, and wild X wild crosses to determine the effect of genetic makeup on the success of various releases. Success will be measurec by the number of adults returning, as well as whether spawning timing is similar to the wild stock.

This project is a multi-year undertaking that will evaluate aififrent management and enhancement strategies. At the conclusion of thsi study, a series of alternatives will be developed that can be used to determine how Lest to enhance the runs of spring chinook in the Yakima Basin. Annual reports were presented in 1983 (Wasserman and Hubble, 1983) and 1984 (Wasserman, Hubble, and Watson, 1985). A detailed description of methods and materials used in this study can be found in these earlier reorts. This current report is concerned wit:: new findings in 1985 an3 re-evaluation of previous data in light of current information.

4.0 DESCRIPTION OF STUDY AREA

The Yakima River is located in central Washington and flows 217 miles from its headvaters in the Cascade Mountains (elevation 2,448 ft) to the Columbia River near Richland at rivermile 335 (Figure 1). The Yakima River Basin drains 6,155 square miles of the east slopes of the Cascade Mountains in Kittitas and Yakima Counties. The Yakima River flows east and south through the Kittitas Valley from its ruggedly glaciated headwaters. South of the valley the river cuts through Manastash and Umtanum ridges in a deep canyon. The river enters the middle valley above Yakima through a gap cut in Selah Ridge and leaves through Union Gap in Ahtanum Ridge. Rattlesnake Hills, crossing eastern Yakima and northern Benton Counties, and the Horse Heaven Hills to the south are prominent features bordering the lower river in its 80 mile reach from Union Gap to the Columbia River. The Yakima River enters the Columbia River near Richland at an elevation of 300 feet.

The major tributaries, with the exception of Satus and Toppenish Creeks, enter the river above the city of Yakima. The Naches River is the largest tributary, entering the Yakima at rivermile 101 and extending 51 miles to the junction of the Bumping and Little Naches Rivers. The Naches River drains an area of 1,106 square miles. Other important tributaries of the Naches include the American and Tieton Rivers and Rattlesnake Creek. Numerous creeks, including Manastash, Taneum, and Svauk, flow into the Yakima in the Kittitas Valley.



fii. 1 Study sites on the Yakima River

Important tridutaries in the upper Yakima are the Teanaway and Cle Elum Rivers. The climate of the Yakima Basin varies from wet-alpine in the Cascade Mountains to semi-arid conditions at the lower elevations. The crest of the mountains receive 5O to 140 inches of precipitation per year while approximately one third cf the basin receives ten inches or less. Summer temperatures average 55 F in the mountains and 82 F in the valleys. During the winter monthly maximum temperatures range from 25 F to 40 F and low temperatures range from -20 F to -25 F.

The Yakima River basin produces 3.5 million acre feet average annual runoff, unregulated. The U.S. Bureau of Reclamation's Yakima Irrigation Project has transformed the semi-arid region into a productive agricultural region. Approximately 500,000 acres are presently under irrigation, consuming 2.25 million acre feet each year. There are numerous dams and irrigation diversions on the river. These include Horn Rapids, Prosser, Sunnyside, Wapato, Roza and Easton. A screening structure is associated with each of these dams except at Easton. For an extensive description of the Yakima Basin, see Bryant and Parkhurst (1950).

In the Yakima system, reservoir storage acts tc regulate flows. Manmade Kachess, Kacheelus, and Cle Elum Lakes in the upper Yakima and Bunping and Rimrock Lakes on the Naches River are the najor storage sites. These storage areas supplement flows during the irrigation season (March-October and store water in the winter. Irrigation and power diversions generally reduce flows in the lower sections of the Yakina River. Sunnyside and Wapato dams near rivermile 108 divert approximately one-half the total river flow at each site into irrigation diversions in the summer and fall. Prosser diversion removes approximately 1 ,400 cfs for irrigation and power production throughout most of the year. Due to the large irrigation diversions at Prosser and Parker, flows drop dramatically in the lower river from June to October. Approximately 50% of the flows withdrawn at diversion sites re-enter the river downstream after being used for irrigation or hydropower.

Prior to 1980, flows remained high on the spawning grounds in September and October for irrigation purposes. Many fish that spavned at this time deposited their eggs in shallow water near the bank. When flows were decreased at the end of the irrigation season, these redds were of ten dewatered. Following court action in 1961 irrigation flows were decreased in the Yakima branch during the first week of September so that this problem would not continue. To offset the reduction of flows from the upper Yakima in September, flow is increased in the Naches River from Bumping and Rimrock Reservoir releases.

5.0 METHODS AND MATERIALS

5.1 NATURAL PRODUCTION

5.1.1 SURVIVAL TO EMERGENCE STUDIES

5.1.1.1 Fry Trapping

Methods for identifying redds and capturing spent female spawners on the spawning grounds were detailed in Wasserman and Hubble (1983). In early February 1985, redd caps (1/8" mesh) were placed over nine previously selected redds in the upper Yakima River between Easton end Cle elum (Figure 1). Redd cap design followed that of Tagart (1976). Caps were constructed to extend a distance of at least one meter from the crown of the redd on all sides. Edges of the cap were buried to 2 depth of nine inches. All caps were installed by February 1985, and each was checked at least twice weekly until the first f ish was captured. Thereafter traps were checked daily except when high flows prevented sampling. Survival to emergence was calculated as the total number of captured emergent fry divided by the estimated number of eggs deposited in each redd.

The number of egggs deposited was calculated using a length fecundity model developed from females sampled during the spawning of the 1985 brood stock. Four replicates of one hundred egg samples taken from each of twenty Yakima River females were weighed. The calculated weight per egg from each fish was applied to the total weight of the remaining eggs from that fish to estimate the fecundity of each individual. Fecundity was regressed against fork length, and a regression model was calculated.

5.1.2.2 Gravel Analysis

Substrate quality of the gravel associated with the selected study redds was assessed in three ways. Four gravel samples were taken on each riffle where a redd was capped. Regression analysis was undertaken to determine the relationship between survival to emergence and percent composition of fine gravels. For six redds successfully capped in 1985, survival was regressed against the percent of the entire gravel sample retained in each of 10 sieves (sizes 75mm, 26.5nnm 13.9mm, 9.5mm, 6.7mm, 3.35mm, 1.7mm, .85mm, .425mm, and .212mm). This follows the methodology of Tagart (1976). Gravel quality was also assessed using the methodology of Tappel and Bjornn (1983). The percent of the sample retained in 9.5mm and .85mm sieves was examined and plotted against survival to emergence. The final quality measurement utililzed was the "fredle index" (fi), as developed by Lotspeich and Everest (1981).

$$fi = \frac{d_g}{S_o}$$

Where:

d_g = mean geometric diameter of the sample, and

so = sorting index = $\left(\frac{d_{75}}{d_{25}}\right)^{1/2}$

Where d75 and d25 are grain sizes at the 75th and 25th percentile, respectively. The value for the "fredle index" was regressed against survival to emergence as well.

5 .1.2 DISTRIBUTION STUDIES

5 .1 .2.1 Beach Seining

Three sites in the Naches River, and 11 on the Yakima River, were selected as seining stations (Figure 1). It was impractical to attempt seining in the major tributaries of the Yakima and Naches Rivers due to high gradient and large substrate.

At each site, 5 seine hauls were made with a 100 x 8 foot net with .25 inch mesh. Seining was usually conducted in glides at the interface between the main current and slower water near the bank. Water depth was usually 3 to 6 feet deep. All 5 hauls were usually set on the same gravel bar and each site was sampled monthly.

Hight stream flows or stream icing precluded sampling during certain months at various sites. Sets were conducted by an individual running with the seine towards midstream, and then swinging downstream until the net was fully extended. A second individual guided the net out and a third anchored the lead line to the shore. A boat with a jet pump was used at sites where deep water prevented running with the net.

Only salmonids were enumerated in seine hauls. Data collected included total numbers of each species and fork length.

5.1.2.2 Electroshocking Surveys

Electroshocking was conducted in selected tributaries and side channels in the Yakima and Naches Rivers during the winter of 1984-85 and the summer of 1985. Sampling was conducted using a Smith-Root Type-VII backpack electrosnockcr. Only salmoniu species were collected. Fist collected were anesthetized with MS-222. Data collected included identification of epecies, numbers of fish, and fork lengths. Since abundance levels were generally low; C.P.U.E. (fish/minute sampled) was used to determine fish abundance.

5 .1 .3 PROSSER SMOLT TRAP

Prosser smolt trap was operated continuously from March 11 to July 31, 1985 except for a two day period (April 12 and 13) when the canal .was dewatered for repairs. Sampl ing was conducted one day per week through mid September. Prosser trap operates from a bypass pipe that shunts fish from rotary drum screens in Chandler Canal back to the mainstem Yakima River. In 1984 and 1985 trapping efficiency (the percentage of migrating fish entering the trap) was calculated via a series of releases of marked fish. The statist ical methodology for efficiency calculations was evaluated by Douglas Chapman of the University of Washington Center for Quantitative Science. A detailed description of the evaluation process can be found in Appendix B of this manuscript. The basic procedure was as follows. Once each week, fish captured in the trap during the night were cold branded. Two groups were branded differently , with one group released two miles upstream from the canal intake, and the second group released in the canal. Efficiency was calculated based on the recapture rate of branded fish.

$$f_i = \frac{C_{ri}}{R_{ri}\,(C_{ci}/R_{ci})}$$

f_i = fraction of fish diverted into the canal

R_{ri} = number released directly into the canal in the it h experiment

R_{ri} = number released directly into the river in the ith experimental

C_{ci} = number recaptured from the canal release in the ith experiment

C_{ri} = number recaptured from the river release in the ith experiment

During the 1984 and 1985 spring chinook smolt migrations a total of 18 separate efficiency tests were performed. A relationship was developed between the combined 1984-85 efficiency data and mean river discharge (see Appendix B for details). Four simultaneous tests using spring chinook and steelhead and one test using spring chinook and hatchery coho were performed. The results of these tests with steelhead and hatchery coho were comparable to the results of the spring chinook tests.

5 .1 .4 WAPATOX SMOLT TRAP

The purpose of Wapatox smolt trap is to monitor the spring chinook smolt outmigration in the spring and prc-smolt outmigration during the remaining portion of the year. Wapatox smolt trap is located on the Naches River at RM 17, just downstream of the confluence of the Tieton and Naches Rivers (see Figure 1). The trap is constructed on the Wapatox by-pass canal. Fish entering the canal are shunted into a by-pass pipe (culvert) by a series of rotating drum screens across the diversion canal.

Wapatox smolt trap began operation on April 1, when the rotary drum screens were put into place, and ceased operation November 10, when the rotary drum screens were removed. The trap was normally checked at least 3 times per week and more often during peak migration periods. Only salmonid species were enunerated. Fish collected were anesthetized with MS-222 and fork length and weight were recorded.

An attempt was made to determine the trap efficiency relative to the total river discharge as was done at the Prosser smolt trap (see 1984 Annual Report) by making a series of releases of marked fish at various disc harges. However results from these releases proved unsuccessful. More releases will be made in 1986 to correlate river discharge to trap efficiency. As an alternate the percent discharge spilled into the canal (P.D.C.) was used as the method to estimate outmigrat ion

$$\text{P.D.C.} = \frac{\text{Canal discharge} \times 100}{\text{River discharge}}$$

This method makes the assumption that the total number of fish diverted into the canal is porportional to the ratio of river discharge to canal discharge. This assumption does not hold at all river discharges. At Prosser smolt trap, the canal P.D.C. method underestimates trap efficiency at low river discharges and would thus tend to overestimate outmigration. (see Annual Report 1984, Appendix).

For days when the trap was inoperable an estimate of the daily catch was made by using the mean daily catch from the two days preceeding and following the closure.

5.1.5 ADULT RETURNS

Adult spring chinook salmon harvested below Prosser in the 1985 Yakima Tribal ceremonial dipnet fishery were monitored under the BIA 638 contract.

The Prosser and Roza Dam adult fish counting stations were monitored in 1985. Counting at Prosser began April 1 and continued through August. Roza Dam was monitored from May 14 through September 30. Water clarity at Roza Dam was such that fish swimming over the counting board could be visually examined for the presence or absence of an adipose fin.

Spawning ground surveys were inititated on the American River in mid-July as part of a coordinated effort between the Yakima Indian Mat ion, the U.S. Fish and Wildlife Service, Washington Department of Fisheries, and the Bureau of Reclamation. Spawning ground surveys were conducted throughout each reach of spawning area once each week. All carcasses were examined for adipose fins, and fork length and mid-eye to hypural plate length was measured. Scale samples were taken, and gonads were examined to determine sex and degree of spawning success in females. Following examination the tail of each fish was removed so it would not be examined more than once.

Several helicopter flights of the Yakima System were made in conjunction with the Bureau of Reclamation during the spawning period to determine spawning timing and general location of redds.

5.1.6 ESTIMATES OF SURVIVAL THROUGH VARIOUS LIFE STAGES

5.1.6.1 Egg to fry:

As previously discussed, survival from egg deposition to emergence vas investigated. Total egg deposition was calculated as mean fecundity of Yakima River females (based on the length fecundity model) multiplied by the number of redds located on the spawning grounds.

The total number of fry produced (F) was calculated as:

F = mean fecundity of Yakima River spavners x number of redds
x survival from egg deposition to emergence.

5.1.6.2 Egg to Smolt:

Survival from egg to smolt (S_{es}) was calculated as:

$$S_{es} = \frac{\text{estimated number of smolts at Prosser}}{\text{total egg deposition for year class.}}$$

5.1.6.3 Fry to Smolt:

Survival from fry to smolt (S_{fs}) was estimated as:

$$S_{fs} = \frac{\text{Number of snolts estiuated to pass Prosser}}{\text{Fry for year class}}$$

Estimates of egg deposition and fry production were made for 1981 to 1985 based on redd counts from spawning ground surveys. Survival from egg to smol t and from fry to smolt were based on 1981 , 82, and 83 redd counts and 1983, 84, and 85 smolt outmigration estimates at Prosser.

5.1.6.4 Smolt to Adult:

The smolt to adult survival (S_{sa}) of wild spring chinook salmon in the Yakima system was calculated from the 1983 smolt outmigration estimated at Prosser and 1984 return of jacks (3 years old fish) and the 1985 return of four year old adults to the Yakima River. The return of five year old adult fish to the system in 1986 will complete the data necessary to calculate the total survival. These five year old fish can only increase the survival rate.

PART 2

5.2 HATCHERY OPERATIONS

5.2.1 OUTPLANTING STUDIES

5.2.1.01 Pre-Smolt Releases

Groups of approximately 100,000 juvenile spring chinook (fry to pre-smolts) were released into the upper Yakima River in June, September, and November of 1985 to determines the optimum timing for hatchery releases. Similar releases were made in 1984. The fry, fingerlings and pre-snolts released in 1985 were from the Leavenworth Fish Hatchery 1984 brood year. The fish were reared at Leavenworth and trucked to the Yakima River and scatter planted at 12 sites between RM 155 and 200. All fish were coded-wire tagged and approximately 10% were cold branded.

5.2.1.2 Smolt Releases

TO assess the effectiveness of rearing fish in earthen ponds and then allowing for a volitional release as smolts, one group of smolts was released from Mary's Pond (RM 190) on the Yakima River. Similar releases were made from Mile Springs Pond in 1983 and 1984. However, the releases from NMile Springs Pond were conducted after the fish had been at the location for a period of approximately five months. Smolts were kept at Mary's Pond for less than one month. A second group of snolts was transported from Leavenworth National Fish Hatchery and released directly into the upper Yakima River at the 12 sites between RM 155 and 200.

On April 1, 2 and 3, 1985, a total of 45,195 spring chinook smolts were transported from Leavenvorth National Fish Hatchery to an acclimation pond located at RN 190 on Mary Huntley's property (Mary's Fond) on the Yakims River. These fish had all been coded-vire tagged and 13% were cold branded.

A volitional release of these fish began on April 10 when the seine blocking the pond exit was removed. On April 26, 1985, the pond was seined to force the several hundred remaining smolts out into the river.

A total of 42,210 spring chinook smolts were transported from Leavenworth Fish Hatchery and released into the upper Yakima River on Arpil 10, 11, and 12, 1985. All fish were coded-wire tagged and 9% were cold branded.

Counts of branded hatchery saolts captured at Prosser smolt trap were used to evaluate freshwater survival of both groups of fish. Based on brand recoveries alone the relative survival of each group was calculated. Total estimated passage of each group yielded absolute survival rate estimates to Prosser. Smolt to adult return rates of these two groups will be determined in 1 986 and 1987 from captures of tagged fish in the ocean, mainstem Columbia River fisheries, the tribal dipent fishery on the Yakima River, and from carcass recoveries on the spawning grounds.

5.2.2 BROOD STOCK EVALUATIONS

Hatchery spring chinook introduced into the Yakima River from 1950 to 1984 have come from numerous sources and stocks (Table 1). An experimental brood stock program was undertaken in 1934 and cont inued in 1985 to evaluate the benefits of using spring chinook from the Yakima River as a source of gametes. The purpose was to permit the propagation of fish native to the basin, thereby maintaining the genetic components indigenous to the Yakima River.

The intent of this investigation was to compare four different release groups: (1) Yakima River males crossed with Leavenworth Hatchery (Carson Stock) females, (2) Yakima males crossed vith Yakima females, (3) Leavenworth males crossed with Leavenworth females. Groups l-3 will be released from an acclimation pond in the upper Yakima River. These groups will be used to determine if cultured fish that are the progeny of Yakima River spring chinook have a greater success in returning to the Yakima River than do non-indigenous stocks. (4) Leavenvorth males crossed with Leavenworth females. This group will be

Table 1. Historical plants of spring chinook in the Yakima River Basin.

Brood Year	Release Date	Hatchery	Size Fish/Lb	Number Released	Brood Stock	Release Location
1958	8/59	Klickitat	143	20,000	Klickitat	Yakima River
1960	5/61	Levenworht	330	18,000	Icicle	Yakim River
1961	2/62	Leavenworht	1000	5,000	Icicle	Yakima River
1962	12/62	Leavenworth	1000	5,000	Icicle	Yakim River
1962	63			12,500		Nile Springs
1963	64			10,000		Nil Springs
1971	6/73	Klickitat	58	162,400	Klickitat	Naches River
1971	6/73	Klickitat	58	162,400	Klickitat	American River
1974	75			8,580		Nile Springs
1974	4/76	Ringold	3	7,230	Ringold	Nile Springs
1974	9/76	Klickitat	29	42,775	Klickitat	Nile Springs
1975	3/77	Klickitat	19	13,300	Klickitat	Nile to Richland
1976	3/78	Klickitat	7	2,462	Cowlitz	Nile Springs
1977	4/79	Carson	20	50,000	Carson	Yakima River
1977	4/79	Klickitat	12	25,000	Cowlitz	Nile Springs
1978	4/80	Klickitat	10	24,000	Klickitat	Nile Springs
1978	4/80	Leavenworth	18	30,260	Carson	Yakima River
1979	4/81	Klickitat	14	33,616	Klickitat	Nile Springs
1979	4/81	Leavenworth	20	400,221	Leavenworth	Yakim River
1980	4/82	Leavenworth	14	100,050	Leavenworth	Nile springs
1980	4/82	Leavenworth	15	401,714	Leavenworth	Yakima River
1981	4-5/83	Leavenworth	17.6	103,110	Leavenworth	Nile Springs
1981	4/83	Leavenworth	19.5	97,012	Leavenworth	Yakima River
1982	4/84	Entiat	19	29,636	Carson	Nile Springs
1982	4/84	Entiat	25	42,552	Carson	Yakima River
1983	6/84	Leavenworth	66	102,837	Carson	Yakima River
1983	9/84	Leavenworth	25	102,833	Carson	Yakima River
1983	11/84	Leavenworth	21.6	108,305	Carson	Yakima River
1983	4/85	Leavenworth	18	50,000	Carson	Yakima R.(ponds)
1984	6/85	Leavenworth	66	100,000	Leavenworth	Yakima River
1984	9/85	Leavenworth	25	100,000	Leavenworth	Yakima River
1984	11/85	Leavenworth	22	100,000	Leavenworth	Yakima River

1/ Klickitat - Native springs chinook run in Klickitat River. Broodstock at times supplemented withCarson, Cowlitz, Eagle Creek, and Williamette Fish.

transported from the hatchery and released directly into the river at Easton. This group will be used as a control to determine the merits of acclimating spring chinook in ponds for 3 to 14 days prior to volitional release. Returns from group four will be compared directly to group three.

5.2.3 ADULT HATCHERY RETURNS

Three groups of adult hatchery fish returned to the Yakima River in 1985. These groups were identified by the coded-wire tags recovered in the spawning ground surveys and carcass recoveuy surveys conducted in September and October of 1985. Recoveries were from the 1982 release of 401 ,714 spring chinook smolts in the upper Yakima and the 1983 releases of 97,011 smolts in the upper Yakima and the 99,725 smolts from the Nile Springs acclimation pond.

The recoveries from the 1982 release group were returning as five year old fish and complete the data necessary to calculate the total survival (jacks, four-year fish, and five-year fish) from smolt tc adult for that release.

The recoveries from the 1983 release groups were for four year old fish only since this was the first year that fish released in 1983 returned as adults (no hatchery jacks were reported in 1984).

Coded-wire tags were recovered from four sources; the Yakima Indian Nation Zone 6 ceremonial and subsistence fishery in the Columbia River, the Yakima dip net fishery, and the spawner surveys and carcass recovery surveys in the Naches and upper Yakima Rivers. All tags recovered were expanded by the sample rate (fish sampled/total number of fish caught for a fishery or carcasses sampled/total number of spawners estimated in each river for spawner surveys) and by the mark rate or coded-wire tag retention rate. This mark rate was only 11.3% in the 1983 release but was 94.8% and 97.1% for the two 1984 release groups.

Survival rate for hatchery smolt to adult was calculated by dividing the total expanded return of adults from each release by the estimated passage of smolts by Prosser from that release. The expanded return numbers were also divided by the total number of smolts released in each group to obtain a hatchery planting to adult rate of survival.

6.0 RESULTS AND DISCUSSION

6.1 NATURAL PRODUCTION

6.1.1 SURVIVAL TO EMERGENCE STUDIES

6.1.1.1 Fry Trapping

Survival to emergence studies were successfully carried out on six of the nine redds capped in February, 1985. The females spawning in the study redds were captured between September 24 and September 28, 1984 (Table 2). The three unsuccessful redds were located just downstream from the site where a streamside resident illegally rechannelized the Yakina River to protect his home. The large amount of sediment carried downstream as a result of this extensive bulldozing was apparently trapped in the fine mesh of the redd capping nets. Sediment affects the survival of salmonids in redds in at least three ways: (1) Direct suffocation of eggs and alevins, (2) reduced intragravel water flow and dissolved oxygen content, and (3) as a physical barrier to emergence (Fast et al., 1982; Fast and Stober, 1984; Koski 1966, 1972; Gibbons and Salo, 1973). Two of the redds had no fry emerge. The third redd had 33 fry emerge **from** an estimated 3,775 eggs deposited for a survival to emergence of 0.91. These redds were not included in the analysis.

Table 2. Location of redds and size of females captured in September 1984 for 1985 survival to emergence studies.

Location	Date Captured	Fork Length (mm)	ME-HP (mm0*
Easton Ridge 1	9/24/84	680	590
Easton Ridge 2	9/24/84	620	565
Easton Ridge 3	9/24/84	705	580
Elk Meadows	9/25/84	737	603
Bullfrog 1	9/26/84	730	600
Bullfrog 2	9/26/84	680	570
Sun Country 1	9/27/84	710	650
Sun Country 2	9/27/84	760	700
West Nelson	9/28/84	680	630

* MEHP = mid-eye to hypural plate length

The mean survival from egg deposition to emergence of the six successfully capped redds was 62.5% and ranged from 29.3 to 84.8% (Table 3). This is much higher than the 20.6% mean and 13.0 to 30.6% range of survival to emergence reported in 1984. Daily totals and cumulative captures for the capped redds are given in Appendix Table A.l. It is believed that more fry were captured this year because of modifications to the redd capp net. The addition of live boxes at the cod end of the net and the placement of vexar under the net reduced the escapnent of fry by reducing the small holes caused by gravel abrasion and also by reducing the water flow that may have forced fry through the cod end mesh. These current results are more in line with laboratory studies conducted by Tappel and Bjornn (1983) in which survival ranged from 66 to 88% when 10 to 12% of the gravel was less than .85mm. Studies conducted by Eoski (1975) indicated the survival to emergence of chum salmon in experinental channels ranged from 7.2 to 88.4% in three years of study, and the annual mean survival ranged from 25.6 to 57.9% The survival to emergence was highest (63%) in gravel containing ll-25% sand (<3.327mm but >0.105mm).

The temperature units (T.U.'s) required for spring chinook emergence in 1985 are presented in Table 4. The mean number of temperature units required for 50% and 100% emergence was 1,937 and 2,215 respectively. These numbers coincide very closely with the means of 1,967 and 2,291 temperature units required for 50 and 100% emergence in the redds capped in 1984.

Table 3. Results of 1985 Yakima River survival to emergence studies.

Location	Sapwning Date	Female Fork Length (mm)	Estimated Number of eggs deposited	Number of Emergent Fry	% Survival	Date of 1st Emergence	Date of 50% Emergence
Easton Ridge 1	09/24/84	680	3,279	2,550	77.8	04/02/85	05/07/85
Easton Ridge 2	09/24/84	620	2,289	1,942	84.8	04/12/85	05/09/85
Easton Ridge 3	09/24/85	705	3,692	1,288	34.9	04/10/85	05/03/85
Elk Meadows	09/25/84	737	4,221	2,863	67.8	05/01/85	05/06/85
Sun Country 2	09/27/84	760	4,600	1,347	29.3	04/01/85	04/01/85
West Nelson	09/28/84	680	3,279	2,626	80.1	04/23/85	05/17/85
Mean		697	3,560	2,103	62.5*		

*This number is the mean of the percent survival of the six redds and is not the same as the percent survival calculated fron the mean of emergent fry (2,103) divided by the mean of eggs deposited (3,560) of the six redds.

Table 4. Temperature units (T.U.'s) required for spring chinook emergence in 1985.

Location	Spawning Date	Date of 1st Emergence	U.U.'s Required	50% Emergence	U.U.'s Required	100% Emergence	T.U.'s Required
Easton Ridge 1	09/24/84	April 2	1,623	May 7	2,019	May 31	2,428
Easton Ridge 2	09/24/84	April 12	1,729	May 9	2,049	May 24	2,300
Easton Ridge 3	09/24/84	April 10	1,707	May 3	1,958	May 24	2,300
Elk Meadcws	09/25/84	May 1	1,912	May 6	1,979	May 24	2,276
sun Country 2	09/27/84	April 1	1,541	April 1	1,541	April 12	1,657
west Nelson	09/28/84	April 23	1,756	May 17	2,078	May 31	2,332
Mean			1711		1937		2215

A length fecundity model was developed based on twenty Yakima River spring chinook females sampled during the spawning of the 1985 brood stock (Figure 2) A statistically significant (P_(.05 R = .87) linear regression model was developed from the twenty length fecundity points (Table 5). The equation that best fits this regression line was

$$Y = 16.51 (x) - 7947.3$$

where Y = estimated number of eggs for a given fork length, and

X = fork length in millimeters

This equation estimates a higher fecundity at any given fork length tnan would be calculated from the 1984 length fecundity model. This equation was applied to the length measurements of the females captured for the survival to emergence studies and the nunber of eggs deposited in each redd was calculated (Table 3).

6.1.1.2 Gravel Analysis

Results of gravel sampling are presented in Appendix Tables A.2. and A.3. From these values, analysis was undertaken to determine the relationship between gravel quality and survival to emergence. The fredle index, as described by Lotspeick and Everest (1981) and the corresponding survival to emergence for each redd is presented in Table 4. There was no significant relationship between survival to emergence 'and the fredle index calculated for each redd.

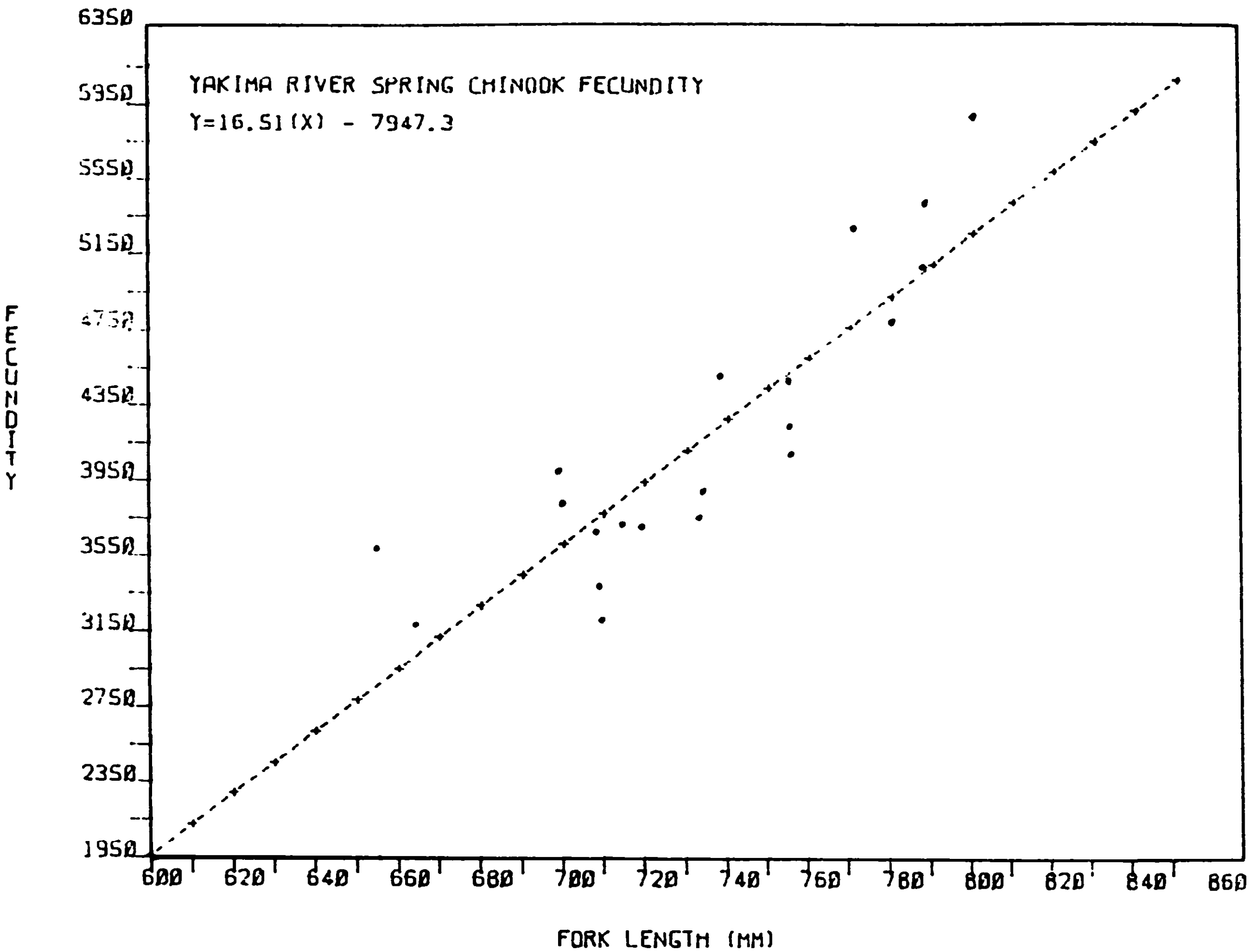


Figure 2 . Length fecundity relationship developed from twenty Yakima River female spawners in 1985.

Table 5. Length fecundity data collected from twenty Yakima River spring chinook females.

Length of Female (mm)	Fecundity
655	3,572
665	3,182
700	3,987
701	3,827
710	3,216
710	3,379
710	3,673
715	3,719
720	3,705
733	3,736
735	3,880
740	4,508
755	4,081
755	4,215
755	4,458
770	5,281
780	4,777
790	5,088
790	5,383
800	5,903
mean 734.5	4,178

Table 6. Calculation of Fredle Index in the Yakica River, 1985.

Site	d_{25}	d_{75}	d_g	s_o	fi
Easton Ridge 1	2.71	16.50	6.62	2.47	2.68
Easton Ridge 2	2.63	13.05	5.85	2.23	2.63
East on Ridge 3	2.91	16.34	6.89	2.37	2.89
Elk Meadows	2.99	20.09	7.69	2.59	2.97
Sun Country	2.72	17.82	7 .oo	2.59	2.73
West Nelson	2.43	12.87	5.55	2.30	2.41

d_g = mean geometric diameter

s_o = sorting index = $\left(\frac{d_{75}}{d_{25}}\right)^{1/2}$

fi = fredle index = $\frac{\text{ci.}}{\text{so}}$

6.1.2 DISTRIBUTIOIN STUDIES

6.1.2.1 Beach Seining

Beach seining was conducted at 13 sites throughout the Yakima Basin from November, 1984 through September, 1985. This is a continuation of work initiated in 1983. Figure 1 depicts the various seining sites throughout the Yakima basin. High stream flows or icing prevented seining at various sites throughout this sampling period. Monthly captures (total fish captured in 5 sets) at each site is shown in Table 7.

In November, fish were captured only at Granger (RH 95) and Prosser (RM 82). A total of 8 and 55 fish were captured respectively. No fish were captured during December and January. This is most likely due to fish burrowing into the substrate because of low water temperatures; thus making capture difficult. In February 6 and 20 total fish *were* captured at West Richland (RM 8) and Granger, respectively. Again, as in January, cold water temperatures hindered seining success. Mean fish lengths for West Richland and Granger were 129 mm and 110 mm respectively.

In March, fish were captured from West Richland to Cle Elum (RM 181). The highest densities were at Toppenish (RM 95) and Yakima Canyon (RM 135) with 31 and 10 fish captured respectively. Mean fish lengths

Table 7. Monthly beach seine captures in the Yakima and Naches River from November, 1984 through September, 1985.

Site River	RM	Monthly Captures										
		Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Yakima	8		0	-	6	4	0	0	0	-	0	0
Yakim	25		0	-	0	1	3	0	0	-	0	0
Yakima	44	0	0	-	0	2	5	0	0	0	0	0
Yakima	82	8	-	c!	0	4	3	0	0	0	0	0
Yakim	95	55	-	0	0	32	19	11	0	0	0	0
Yakima	118	o	-	-	0	1	6	1,221	130	-		0
Yakim	135					10	26	61	35	-		1
Yakima	152				0	c	4	37	2	-		3
Yakima	169				0	0	-	10	-	-		17
Yakima	181	0	0	0	0	2	9	1,020	6			2
Yakima	195	0	0	-	0	0	7	10	13	-		0
Naches	9					0	16	50	694	230	3	13
Naches	31					7	3	15	352	43	3	63
Nac hes	42						1	4	7	65		56

at these two sites were 113 mm and 105 mm respectively. The mean fish length at Granger was 133 mm. A single newly emerged fry was captured at Selat. (mm 118) In 1985 spring chinook spawning was documented for the first time as occurring in this river reach. In previous years newiy emerged fry found at Selah were thought to have outmigrated from spawning areas further upstream. However, it is most likely that these fry had originated from this river reach.

In April, fish were captured from Benton (RM 25) to Easton (RM 195). Toppenish and Yakina Canyon had the highest densities with 19 and 26 captured fish respectively. Catches were comprised of smolts at all but Selah and Cle Elun where young-of-the-year fish were captured.

In May fish were not captured in the lower Yakima River from Granger downstream. Factors for this are completion of the smolt outmigration and increasing stream temperatures. Fish were captured throughtout the upper Yakima River. High numbers of young-of-the-year fish were captured at both Selah and Cle Elun; 1,221 and 1,020 total fish respectively. fish at these two sites had mean lengths of 54 mm and 44 mm respectively. Increased captures were seen at Yakima Canyon, Ellensburg (RM 152) and Rhorp (RM 169) relative to April. The mean length for fish captured at Yakima Canyon and Thorp was 65 mm indicating that these fish may have emerged earlier and were migrating downstream fron the Cle Elum and Easton areas where most the spawning occurs.

In June a total of 130 and 35 fish were captured from Selah to

Easton respectively. Fish in the Yakima Canyon had a mean length of 71 mm. The continued high number of captures (130 total fish) at Selah indicates that rearing of newly emerged fry is occurring in this spawning area. The mean length of fish captures was 68 mm, indicating a growth of 14 mm in one month or the movement of larger fish downstream from the Yakima Canyon.

Beach seining was continued in the upper Yakima River in July and August. No fish were captured in the lower river during September. This is due to the combined effects of high stream temperatures and reduced water quality during the summer months. Fish were captured at all upper river sites except Easton. Thorp had the highest catch with 17 total fish.

Naches River:

Icing prevented sampling in the Naches River from November through February. In March the upper site (RM 42) was not sampled because of icing. A total of 7 fish were captured at the middle site (RM 31). Their mean length was 87 mm. In April, fish were captured at all three sites. The lower site (RM 9) had the highest number of captures with 16 fish total. One of these was a young-of-the-year fish.

In May, captures were again highest at the lower site and progressively decreased moving upstream. Captures ranged from 50 fish at the lower site to 4 fish et the upper site. Similar results were found in June. however, total fish captured at the lower and middle sites were greater, with 694 and 352 fish respectively. Mean fish length for both sites combined was 52 mm. As observed in previous years, this indicates a downstream movement of young-of-the-year fish throughout the late spring and summer from the spawning areas further upstream.

In July, the highest captures were at the lower site with 230 fish total. this was down from the previous month. There was nearly a ten fold increase in total captures at the upper site from June to July. Mean fish lengths ranged fron *57* mm at the middle site (mm 31) to 80 mm at the lower site. This similarity was observed in previous years at this upper site indicating that young-of-the-year fish are moving downstream out of the tributaries (American, Little Naches and Bumping Rivers) and rearing in the upper Naches River.

In August, a total of 3 fish were captured at both the lower and middle sites. High stream flows precluded seining at the upper site. Although seining was conducted at the lower and middle sites in August the higher than normal stream flows may have had an adverse impact on seining efficiency. Captures in September were again high in the same areas they had been in July. In September, highest captures were found at the middle and upper sites with 63 and 56 total fish respectively. Mean fish lengths ranged from 32 mm at the upper site to 95 mm at the lower site.

6 .1.2.21 Electroshocking Surveys

Electroshocking surveys were conducted in selected tributaries within the Yakima River during the winter of 1984-85 to determine winter utilization by spring chinook. Results are presented in Table 8. No spring chinook were captured in Big (RM .1), Manastash (RM 1.4), Dry or Toppenish (RM 2.4) Creeks. The C.P.U.E. and density (where available) in the remaining tributaries were low. The range in C.P.U.E. was .02 f ish/minute to .58 fish/minute. The highest C.P.U.E. was in Pianastash (RM .5) and Wide Hollow (RM .9) Creeks with .58 fish/minute.

The results seem to indicate that in general these tributaries are not being heavily utilized for over wintering. Wide Hollow Creek, which enters the Yakima River at RM 107, is the only tributary that has been devoid of spring chinook during the summer, but has shown the highest abundance of fish during the winter in the past two years. The mean C.P.U.E. for combined years was .545 fish/minute in the winter.

Table 9 presents the results for tributaries and side channels sampled in the Yakima or Naches Rivers during the summer of 1985. A total of four side channels of the Yakima River were sampled. They were all located from RM 179 to RM 200. The C.P.U.E. ranged from .45 to .98 fish/minute. The mean C.P.U.E. was .60 fish/minute.

Table 8. Summary of electroshocking data for spring chinook in the Yakima and Nahces River systems, Winter 1984-85.

Stream	Date	RM	Spring chinook Type	CPUE Fish/min	Fish/m2	X (mm)	SD	N
Big	2-17	1.5	wild	.03	2.01	98		1
Big	2-18	.1		.00				
Swauk	l-22	.3	wild	.12		109	11.1	6
Swauk	l-22	.3	hatchery	.18		120	10.3	7
Taneum	l-25	.1	wild	.03	<.01	116		1
Taneum	l-25	.1	hatchery	.13	.04 (0-.24)	117	6.6	9
Manastash	2-28	1.4		.00				
Manastash	2-27	.5	wild	.58	.07 (.07-.08)	111	6.6	28
Manastash	2-27	.5	hatchery	.12	.01 (.01)	122	6.8	4
Dry	2-1	.7		.00				
Wenas	1-21	.1	wild	.04				
Wenas	1-21	.1	hatchery	.22				
Wide Hollow	1-2	.9	wild	.58	.03 (.02-.03)	118	7.0	
Ahtanum	11-15	.9	hatchery	.03				
Ahtanum	11-15	1.0	wild	.09	<.01 (0-.02)			
Wanity	2-13	.1	wild	.02				
Toppenish	l-24	.1		.00				
Toppenish	1-18	2.4		.00				

Table 9. Summary of electroshocking data for spring chinook in the Yakima and Nahces River systems, summer 1985.

Strean	Date	RM	CPUE Fish/min	Fish/m2	X (MM)	SD	N
Yakima	7-11	201.0	.45		55	9.5	14
Big	7-03	0.1	.25		61	10.3	18
Yakima	7-09	198.0	.98	.19 (.18-.20)	61	7.0	23
Yakima	7-08	199.5	.50		56	7.0	51
Little	7-12	0.3	.00				
Swauk	7-19	2.2	.12				
Swauk	7-18	1.0	.21		61	3.9	9
Taneum	7-26	0.2	.08		64	2.6	3
Manastash	7-16	1.4	.24	.01 (.03-.04)			
Manastash	7-17	0.5	.60	.03 (.03-.04)	84	6.7	19
Manastash	7-09	0.7	.06				
Yakima	7-16	179.0	.46	.01 (0 - .02)	71	19.4	18
Ahtanum	7-30	1.0	.00				
American	8-05	7.3	.53	.02 (.02)	56	11.7	50
American	8-01	9.5	1.16	.10 (.10)	60	13.6	155
Little Nahces	7-29	6.1	.04				
Little Naches	8-09	3.2	.20	.11 (.09-.14)	64	9.8	41
Union	8-07	0.3	.11		56	5.7	2
Quartz	8-07	0.1	.12		61	3.8	3
Crow	8-07	1.0	.43		54	8.2	17
Rock	8-21	0.2	.69				
Lost	8-23	0.1	.44		67	5.0	13

No spring chinook were found in either Little or Ahtanum Creeks. Of the remaining Yakina River tributaries C.P.U.E.'s varied fron .06 fish/minute in middle Nahastash Creek (RM .7) to .60 fish/minute in lower Manastash Creek (RM .5). In general C.P.U.E.'s for spring chinook were comparable to those observed in previous years.

The American River was sampled at two sites, RM 9.5 and RN 7.3. The densities (spring chinook/m2) were .02 and .lO respectively. The lower site (R.M 7.3)m showed a 17 fold decrease in abundance from 1984. Two sites were also sampled on the Little Naches River, at RM 3.2 and RM 6.1. Tneir respective C.P.U.E. for spring chinook were .04 and .20 fish/minute.

Quartz and Cow Creeks, two tributaries to the Little Naches River had C.P.U.E.'s of .12 and .43 fish/minute. Union Creek, a tributary to the American River, had a C.P.U.E. of .ll fish/minute.

Rock and Lost Creeks, tributaries to the Nahces River, had respective C.P.U.E.'s of .69 and .44 fish/minute.

6.1.3 PROSSER SHOLT TRAP

6.1.3.1 Wild Fish

A substantial change in the relationship between the river discharge diverted into Chandler Canal and the percent entrainment of outmigrating salmonids was produced when test release data from 1985 was merged with data from 1954 (see Appendix Combined data best described a logistic relationship that, relative to the exponential 1954 relationship, predicted substantially higher efficiencies over approximately 60 percent of the diversion range. Because higher efficiencies of capture result in lower estimates of outmigtation, recapture data from 1983 and 1964 was rc-analyzed, and the results are presented with that for 1985.

The relationship between percent canal diversion and efficency is not expected to change significantly with additional data. By the end of the 1985 season, capture efficiencies had been estimated over most of the range of diversions of river into canal, and the basic from of the relationship has been described. Barring unexpected discoveries, additional data should produce only minor changes in the diversion - capture efficiency relationship.

A fyke net was operated in Chandler Canal around the clock from January 24, 1985 through February 3, 1965, and from February 13, 1985 through March 2, 1985 (Anonymous, 1985). The total number of juvenile wild chinook estimated to have entered Chandler Canal during the days sampled during January, February and March was 704, 628 and 10, respectively. Comparable figures for juvenile steelhead are 3, 733, and 0. The total estimated outmigration for wild chinook and steelhead were 3,637 and 2,487 respectively on the days the net was operated.

Although the full implication of these data remains to be determined, it would appear that juvenile chinook and steelhead undertake a downstream migration of some magnitude in late winter, well before the spring smolt run. Further work in 1986 and 1987 should reveal tne true magnitude and significance of this phenomenon.

Trapping at the Chandler Canal smolt trap began March 11 and continued on a 24-hour basis through July 31, except for a two-day period (April 12 and 13) when the canal was dewatered for emergency repairs (catches for these days were estimated by averaging the catches two days before and two after the period of down-time). The trap was operated one day per week from July 31 through October first.

A total of 242,207 salmonids (excluding whitefish, which were not moitored) were counted in 1985. Lengths and weights were taken f from random samples of all species and release groups on a daily basis. The total catch included 46,541 wild spring chinook, 29,912 hatchery spring chinook, 41,126 wild fall chinook, 33,299 wild steelhead, 18,615 hatchery steelehad and 70,449 hatchery coho (Table 10). No salmonids were captured in August or September.

TABLE 10. Weekly captures at Prosser smolt trap, 1985.

Dates	Wild spring chinook	Hatchery spring chinook	Acclimated spring chinook	Trucked spring chinook	Hatchery spring chinook finglerlings	Wild steelhead	Hatchery steelhead	Wild fall chinook	Hatchery fall chinook	November hatchery spring chinook parrs	September hatchery spring chinook parrs	Hatchery coho	Rattlesnake creek hatchery spring chinook
3/1-3/7	0	0	0	0	0	0	0	0	0	0	0	0	0
3/8-3/14	6	0	0	0	0	8	0	0	0	0	0	0	0
3/15-3/21	20	3	0	0	0	38	0	0	0	0	0	0	0
3/22-3/81	135	18	0	0	0	168	0	0	0	0	1	0	0
MONTHLY TOTAL	(161)	(21)	(0)	(0)	(0)	(214)	(0)	(0)	(0)	(0)	(1)	(0)	(0)
4/1-4/7	509	179	0	0	0	687	8	0	0	11	14	0	0
4/8-4/14	1,249	220	0	0	0	482	20	31	0	9	17	0	1
4/15-4/21	809	157	0	1	0	947	968	109	0	12	0	6	6
4/22-4/30	13,488	7,527	260	74	0	6,504	6,716	563	0	74	158	0	641
MONTHLY TOTAL	(16,055)	(8,083)	(260)	(75)	(0)	(8,570)	(7,722)	(703)	(0)	(97)	(201)	(0)	(648)
5/1-5/7	10,613	8,406	280	176	0	6,906	3,810	2,554	0	52	94	0	1,594
5/8-5/14	5,266	5,113	142	108	0	6,074	1,970	4,663	0	19	58	0	1,071
5/15-5/21	6,394	5,226	147	164	0	6,812	3,103	8,298	0	16	37	0	1,298
5/22-5/31	4,324	2,234	67	80	0	2,535	1,483	7,244	0	9	10	39	376
MONTHLY TOTAL	(26,597)	(20,979)	(639)	(528)	(0)	(22,327)	(10,366)	(10,366)	(0)	(96)	(202)	(39)	(4,339)
6/1-6/7	3,155	393	11	6	0	1,616	389	9,463	0	2	0	60,741	100
6/8-6/14	719	72	0	3	1	283	90	4,865	0	0	2	8,409	15
6/15-6/21	127	226	0	0	0	191	32	2,319	24	0	0	944	4
6/22-6/30	27	130	0	0	15	79	12	501	660	0	0	246	7
MONTHLY TOTAL	(4,028)	(821)	(11)	(9)	(16)	(2,169)	(523)	(17,148)	(684)	(2)	(2)	(70,340)	(126)
7/1-7/7	0	6	0	0	93	16	4	305	829	0	0	66	1
7/8-7/14	0	2	0	0	58	1	0	110	170	0	0	3	1
7/15-7/21	0	0	0	0	45	2	0	60	40	0	0	1	0
7/22-7/31	0	0	0	0	27	0	0	41	3	0	0	0	0
MONTHLY TOTAL	(0)	(8)	(0)	(0)	(223)	(19)	(4)	(516)	(1,042)	(0)	(0)	(70)	(2)
SEASON TOTAL	(46,841)	(29,912)	(907)	(612)	(239)	(33,299)	(18,615)	(41,126)	(1,726)	(195)	(406)	(70,449)	(5,115)

1. Trapping did not begin until 3/11/85.
2. Hatchery spring chinook, age-I, acclimated 4/1/85-4/3/85, in pond at RM 192, Yakima River, allowed volitional release 11/11/85.
3. Hatchery spring chinook, age-I, scatter-platted 4/10/85-5/12/85 in Yakima River, median release point RM 165.
4. Canal empty 4/12-4/13.
5. Hatchery spring chinook, age-0, scatter-planted 6/11/85 in Yakima River, median release point RM 165.
6. Hatchery steelhead, age-I, released 4/8/85 in lower Naches River.
7. Hatchery fall chinook, age-0, released 6/13/85 at Sunnyside Dam and confluence of Naches and Yakima Rivers.
8. Hatchery spring chinook, scatter-planted 11/6/85-11/7/85 as age-0 parr, in Yakima River, median release point RM 165.
9. Hatchery spring chinook, scatter-planted 9/11/85-9/12/85 asage-0 parr, inYakima River, median release point RM 165.
10. Hatchery coho, scatter-planted 5/28/85-5/31/85 from confluence of Naches and Yakima Rivers to Wapato Dam.
11. Hatchery spring chinook, age-I, released 4/8/85-4/9/85, 8 miles up Rattlesnake Creek (confluence with Naches River at RM 28).

Three wild chinook, all precocious males, were caught October 1, the last day the trap was operated.

The monthly length frequencies of wild chinook sampled in 1985 are depicted in Figures 3, 4, and 5. Two points are evident from these distributions: that lengths are occasionally bimodally distributed, and thar lenghs generally decrease as the season progresses.

It has been tentatively determined from scale analysis (Wasserman and Eubble, 1983) that the smaller mode of biomodal distributions represents fall chinook. Weekly length frequency analyses are currently used for discriminating between spring and fall chinook. Fall chinook are classified as those wild chinook smolts which comprise this lower mode. Note that the length distributions for March and July are uninodel, while June is rather anbiguous. A similar situation occurs for the March and July length distributions in 1983 and 1984. In all three years, length frequencies indicate that all wild chinook are spring chinook in March, with the proportion of fall chinook gradually increasing through April, May and June until, by July, it represents essentialiy 100 percent.

In 1985, there was a tendency for spring chinook to decrease in size while fall chinook increased in size as the season progressed (Table 11). These trends were less marked in 1983 and even less in 1984. Spring chinook in 1983 were almost always smaller than in 1984 or 1985.

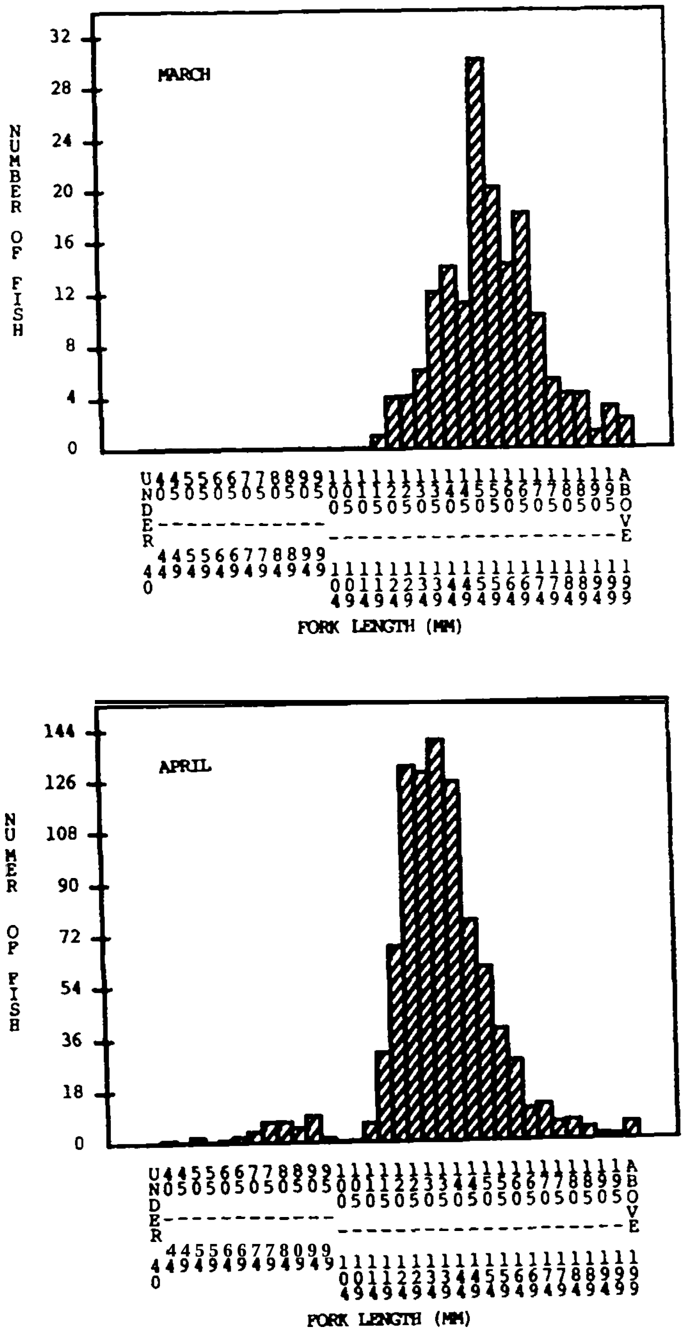


Figure 3 . Length frequency distribution for wild spring chinook caught at Prosser smolt trap in March and April of 1985.

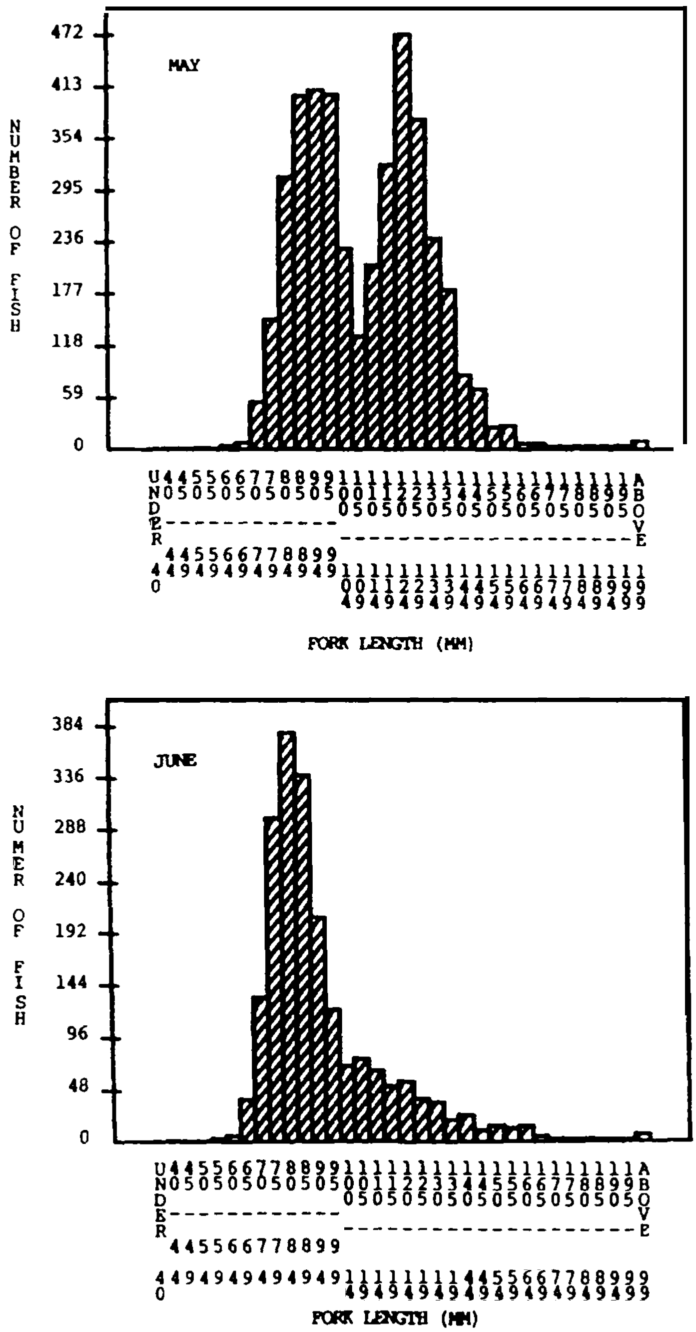


Figure 4 . Length frequency distribution for wild spring chinook caught at Prosser smolt trap in May and June of 1985.

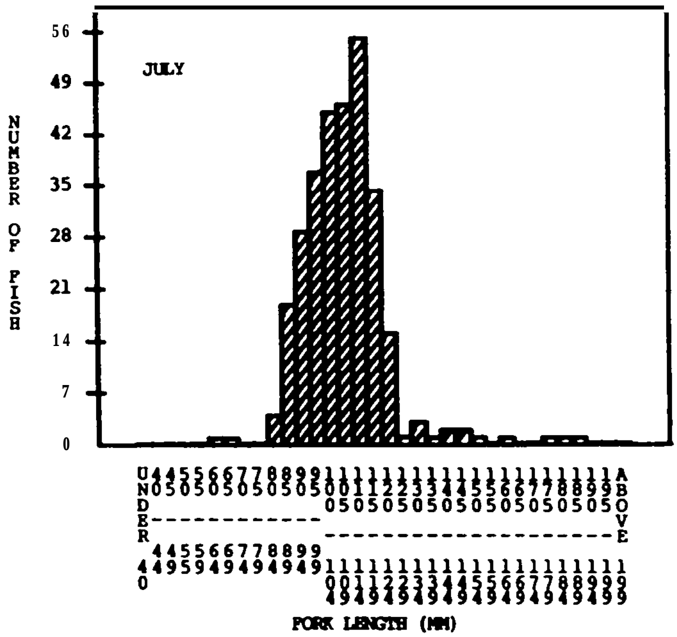


Figure 5. Length frequency distribution for wild spring chinook caught at Prosser smolt trap in July of 1985.

Table 11. Monthly mean length and weight statistics for wild spring and fall chinook captured March through July in 1983, 1984 and 1985 at Prosser Smolt trap.

Spring chinook

Year	March Fork length (mm)	March Weight (gm)	March Condition factor /1	April Fork length (mm)	April Weight (gm)	April Condition factor /1	May Fork length (mm)	May Weight (gm)	May Condition factor /1	June Fork length (mm)	June Weight (gm)	June Condition factor /1	July Fork length (mm)	July Weight (gm)	July Condition factor /1
1983	---/2	---/2	---/2	129	24.5	11.1	126	24.2	11.0	127	no data	no data	---/3	---/3	---/3
1984	134	26.3	10.8	133	25.8	10.8	135	25.9	10.3	140	32.4	10.7	---/3	---/3	---/3
1985	156	44.1	11.0	139	30.1	10.7	126	22.0	10.2	134	33.3	10.7	---/3	---/3	---/3

Fall chinook

Year	March Fork length (mm)	March Weight (gm)	March Condition factor /1	April Fork length (mm)	April Weight (gm)	April Condition factor /1	May Fork length (mm)	May Weight (gm)	May Condition factor /1	June Fork length (mm)	June Weight (gm)	June Condition factor /1	July Fork length (mm)	July Weight (gm)	July Condition factor /1
1983	---/4	---/4	---/4	88	9.2	12.3	89	9.0	12.3	90	10.5	13.5	103	14.0	13.0
1984	---/4	---/4	---/4	---/5	---/5	---/5	94	10.7	12.2	99	12.6	11.7	108	no data	no data
1985	---/4	---/4	---/4	79	5.6	10.8	90	8.6	10.8	86	9.0	11.4	106	18.0	15.2

1. Condition factor expressed as W/L3 x 1,000,000, where W = weight in grams, and L = fork length in millimeters.
2. Trap not operated in March, 1983.
3. All wild chinook captured in July classed as fall chinook.
4. All wild chinook captured in March classed as spring chinook.
5. No fall chinook were captured in April, 1984.

Table 12. Outmigration for 1 985 ,Prosser trap
Upper figure is logistic estimate and **lower figures are approximately 90% confidence interval**

DATES	WILD SPRING CHINOOK	WILD FALL CHINOOK	HATCH. SPRING CHINOOK	HATCH. FALL CHINOOK (BRANDS)	HATCH. FALL CHINOOK	WILD STEEL HEAD	HATCH. STEEL HEAD	HATCH. COHO	RATTLE SNAKE SPRING CHINOOK	NOV.'84 CHINOOK PARR (BRANDS)	NOV.'84 CHINOOK PARR	SEP.'84 CHINOOK PARR (BRANDS)	SEP.'84 CHINOOK PARR	TRUCK'85 CHINOOK SMOLTS (BRANDS)	TRUCK'85 CHINOOK SMOLTS	POND '85 CHINOOK SMOLTS (BRANDS)	POND '85 CHINOOK SMOLTS	JUNE'85 CHINOOK FRY (BRANDS)	JUNE'85 CHINOOK FRY
3/11-3/14	19	0		0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0
3/11-3/14	12	0		0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	8
3/1:-3/14	20	·,		0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	
3/15-3/21	63	0	10	0	0	127	0	0	0	0	0	0	0	0	0	0	0	0	0
3/15-3/21	43	0	6	0	0	83	0	0	0	0	0	0	0	8	0	0	0	0	0
3/15-3/21	74	0	10	0	0	152	0	0	0	0	0	0	0		0	0	0	0	0
3/22-3/31	278	0	40	0	0	344	0	0	0	0	0	1	3	0	0	0	0	0	0
3/22-3/31	239	0	34	0	0	294	0	0	0	0	0	1	3	0	0	0	0	0	0
3/22-3/31	337	0	42	0	0	415	0	0	0	0	0	1	3	0	0	0	0	0	0
SUBTOTAL	360	0	50	0	0	496	0	0	0	0	0	1	3	0	0	0	0	0	0
SUBTOTAL	294	0	40	0	0	394	0	0	0	0	0	1	3	0	0	0	0	0	0
SUBTOTAL	431	0	52	0	0	595	0	0	0	0	0	1	3	0	0	0	0	0	0
4/1---4/7	1954	0	689	0	0	2208	31	0	0	39	290	60	383	0	0	0	0	0	0
4/1---4/7	1170	0	412	0	0	1395	19	0	0	23	184	35	216	0	0	0	0	0	0
4/1---4/7	2564	0	903	0	0	2883	37	0	0	48	ƆTT	77	509	0	0	0	0	0	0
4/8--4/14	11518	ZTT	2572	0	0	4626	1832	0	48	45	442	285	2059	0	0	0	0	0	0
4/8--4/14	4183	102	784	0	0	1621	335	0	4	22	220	67	552	0	0	0	0	0	0
4/8--4/14	16809	388	4225	0	0	6996	3382	0	124	50	523	532	3549	0	0	0	0	0	0
4/15-4/21	13926	1877	2311	0	0	8716	8853	0	96	25	260	171	1471	37	370	0	0	0	0
4/15-4/21	3023	408	547	0	0	2799	2895	0	21	9	75	43	353	4	43	0	0	0	0
4/15-4/21	11253	1509	1956	0	0	869T	8554	0	74	21	206	132	1135	40	400	0	0	0	0
4/22-4/30	15651	654	8847	0	0	8Z88	8395	0	763	86	1181	186	2491	88	1282	306	3125	0	0
4/22-4/30	15136	6ƆƎ	8593	0	0	7880	8008	0	TΛ9	82	1137	181	2410	83	1247	298	3049	0	0
4/22-4/30	18206	TS6	10370	0	0	9762	9853	0	901	94	1362	214	2908	98	1506	355	3674	0	0
SUBTOTAL	43049	2808	14419	0	0	23838	19111	0	90T	195	2173	702	6404	125	1652	306	3125	0	0
SUBTOTAL	23512	1143	10336	0	0	13695	11257	0	774	136	1616	326	3531	87	1290	298	3049	0	0
SUBTOTAL	48832	2653	17454	0	0	28338	21826	0	1099	213	2468	955	8101	138	1906	355	3674	0	0
S/I---S/T	12751	3067	10200	0	0	8382	4630	0	1927	64	815	114	1379	214	2964	ƆΛO	3117	0	0
S/I---S/T	12438	2994	9988	0	0	8206	4535	0	1884	64	801	112	1351	209	2899	334	3052	0	0
S/I---S/T	14878	3579	11986	0	0	9848	5442	0	2256	TZ	962	131	1619	249	3477	397	3659	0	0
5/8--5/14	5601	4959	5442	0	0	6465	2095	0	1140	19	268	61	703	116	1731	151	1601	0	0
5/8--5/14	5299	4692	5150	0	0	6116	1984	0	1080	19	253	59	669	109	1636	143	1511	0	0
5/8—5/14	6144	5440	5970	0	0	T089	2302	0	1251	20	290	67	TTT	123	1893	163	1745	0	0
5/15-5/21	8158	10585	7598	0	0	9029	4564	0	1847	23	285	58	635	243	2949	215	1881	0	0
5/15-5/21	7598	9859	7062	0	0	8409	4235	0	1724	20	264	53	585	ZZT	2746	199	1743	0	0
5/15-5/21	9385	12181	9011	0	0	10480	5419	0	2183	24	331	66	758	286	3506	252	2217	0	0
5/22-5/31	7227	12110	3893	0	0	4406	2672	56	669	15	183	23	233	138	1588	123	1085	0	0
5/22-5/31	6718	11253	3597	0	0	4076	2460	56	618	15	171	21	217	130	1479	111	982	0	0
5/22-5/31	8856	14842	4782	0	0	5421	3283	67	822	18	222	27	285	166	1955	146	1324	0	8
SUBTOTAL	33737	30721	27133	0	0	28282	13961	56	5583	121	1551	256	2950	711	9232	829	7684	0	
SUBTOTAL	32053	28798	25797	0	0	26807	13214	56	5306	118	1489	245	2822	675	8760	TRT	7288	0	0
SUBTOTAL	39263	36042	31749	0	0	32838	16446	67	6512	134	1805	291	3439	824	10831	958	8945	0	0

Table 12 **(cont.)** Outmigration for 1985, Porsser trap
Upper figure is logistic estimate and lower figures are approximately 90% confidence interval

DATES	WILD SPRING CHINOOK	WILD FALL CHINOOK	HATCH. SPRING CHINOOK	HATCH. FALL CHINOOK (BRANDS)	HATCH. FALL CHINOOK	WILD STEEL HEAD	HATCH. STEEL HEAD	HATCH. COHO	RATTLE SNAKE SPRING CHINOOK	NOV.'84 CHINOOK PARR (BRANDS)	NOV.'84 CHINOOK PARR	SEP.'84 CHINOOK PARR (BRANDS)	SEP.'84 CHINOOK PARR	TRUCK'85 CHINOOK SMOLTS (BRANDS)	TRUCK'85 CHINOOK SMOLTS	POND '85 CHINOOK SMOLTS (BRANDS)	POND '85 CHINOOK SMOLTS	JUNE'85 CHINOOK FRY (BRANDS)	JUNE'85 CHINOOK FRY
5/1---6/7	3591	10774	449	0	0	1859	442	69625	115	2	12	0	0	6	82	11	120	0	0
6/1---6/7	3419	10253	429	0	0	1783	420	66717	109	2	11	0	0	6	78	11	115	0	0
6/1---6/7	4185	12557	520	0	0	2177	510	81605	130	2	14	0	0	6	94	12	138	0	0
6/8—6/14	1661	11229	154	0	0	802	212	19571	37	0	0	4	29	9	40	0	0	1	1
6/8—6/14	1280	8664	120	0	0	548	158	14614	27	0	0	3	25	6	29	0	0	1	1
6/8--6/14	2144	14520	199	0	0	1093	273	25839	46	0	0	4	36	10	52	0	0	1	1
6/15-6/21	142	2597	255	25	308	211	34	1060	4	0	0	0	0	0	0	0	0	0	0
6/15-6/21	137	2493	244	24	293	201	33	1019	4	0	0	0	0	0	0	0	0	0	0
6/15-6/21	160	2960	287	27	345	233	36	1210	4	0	0	0	0	0	0	0	0	0	0
6/22-6/30	27	524	136	692	7305	82	12	258	7	0	0	0	0	0	0	0	0	15	230
6/22-6/30	27	501	130	660	6964	79	12	246	7	0	0	0	0	0	0	0	0	15	219
6/22-6/30	28	584	149	773	8182	89	12	286	7	0	0	0	0	0	0	0	0	16	253
SUBTOTAL	5421	25124	994	717	7613	2954	700	90514	163	2	12	4	29	15	122	11	120	16	231
SUBTOTAL	4863	21911	923	684	7257	2611	623	82596	147	2	11	3	25	12	107	11	115	16	220
SUBTOTAL	6517	30621	1155	800	8527	3592	831	108940	187	2	14	4	36	16	146	12	138	17	254
7/1---7/7	0	324	6	875	11795	16	4	69	1	0	0	0	0	0	0	0	0	97	1567
7/1---7/7	0	305	6	829	11196	16	4	66	1	0	0	0	0	0	0	0	0	93	1486
7/1---7/7	0	350	6	961	13096	16	4	73	1	0	0	0	0	0	0	0	0	105	1732
7/8—7/14	0	112	2	177	2252	1	0	3	1	0	0	0	0	0	0	0	0	60	1178
7/8--7/14	0	110	2	170	2163	1	0	3	1	0	0	0	0	0	0	0	0	58	1132
7/8--7/14	0	131	2	205	2631	1	0	3	1	0	0	0	0	0	0	0	0	68	1380
7/15-7/21	0	61	0	41	451	2	0	1	0	0	0	0	0	0	0	0	0	47	709
7/15-7/21	0	60	0	40	433	2	0	1	0	0	0	0	0	0	0	0	0	45	681
7/15-7/21	0	70	0	46	529	2	0	1	0	0	0	0	0	0	0	0	0	52	827
7/22-7/31	0	41	0	3	33	0	0	0	0	0	0	0	0	0	0	0	0	27	347
7/22-7/31	0	41	0	3	32	0	0	0	0	0	0	0	0	0	0	0	0	27	333
7/22-7/31	0	47	0	3	37	0	0	0	0	0	0	0	0	0	0	0	0	29	413
SUBTOTAL	0	538	8	1096	14531	19	4	73	2	0	0	0	0	0	0	0	0	231	3801
SUBTOTAL	0	516	8	1042	13824	19	4	70	2	0	0	0	0	0	0	0	0	223	3632
SUBTOTAL	0	598	8	1215	16293	19	4	77	2	0	0	0	0	0	0	0	0	254	4352
SEASON	82567	59191	42604	1813	22144	55589	33776	90643	6655	318	3736	963	9386	851	11006	1146	10929	247	4032
SEASON	60722	52368	37104	1726	21081	43526	25098	82722	6229	256	3116	575	6381	774	10157	1096	10452	239	3852
SEASON	95043	69914	50418	2015	24820	65382	39107	109084	7800	349	4287	1251	11579	978	12883	1325	12757	271	4606

Table 13. Outmigration for 1984, Prosser trap
Upper figure is logistic estimate
Lower figures are approximate 90% confidence interval

Dates	Wild spring chnook	Hatch. spring chinook	Pond'84 chinook smolts (brands)	Truck'84 chinook smolts (brands)	Wild steelhead	Hatch. steelhead	Wild fall chinook	Hatch. fall chinook	June'84 chinook fry
3/5---3/7	46	0	0	0	7	0	0	0	0
3/5---3/7	28	0	0	0	4	0	0	0	0
3/5---3/7	69	0	0	0	a	0	0	0	0
3/8--3/14	78	0	0	0	32	0	0	0	0
3/8--3/14	64	0	0	0	28	0	0	0	0
3/8--3/14	93	0	0	0	39	0	0	0	0
3/15-3/21	131	0	0	0	169	0	0	0	0
3/15-3/21	93	0	0	0	121	0	0	0	0
3/15-3/21	158	0	0	0	205	0	0	0	0
3/22-3/31	2506	0	0	0	3012	0	0	0	0
3/22-3/31	1198	0	0	0	1450	0	0	0	0
3/22-3/31	5429	0	0	0	6164	0	0	0	0
SUBTOTAL	2761	0	0	0	3220	0	0	0	0
SUBTOTAL	1383	0	0	0	1603	0	0	0	0
SUBTOTAL	5749	0	0	0	6416	0	0	0	0
4/1---4/7	7798	0	0	0	2322	0	0	0	0
4/1---4/7	6380	0	0	0	1834	0	0	0	0
4/1---4/7	9499	0	0	0	2824	0	0	0	0
4/8--4/14	6326	5	0	0	2327	0	0	0	0
4/8--4/14	6092	5	0	0	2253	0	0	0	0
4/8--4/14	7857	6	0	0	2893	0	0	0	0
4/15-4/21	21053	754	94	21	9078	1525	0	0	0
4/15-4/21	20002	689	a5	19	8597	1388	0	0	0
4/15-4/21	26028	929	116	25	11221	la75	0	0	0
4/22-4/30	16526	2561	657	332	8983	4414	0	0	0
4/22-4/30	16269	2532	646	325	8802	43l3	0	0	0
4/22-4/30	20403	3150	807	410	11065	5451	0	0	0
SUBTOTAL	51703	3320	751	353	22710	5939	0	0	0
SUBTOTAL	48743	3226	731	344	21486	5701	0	0	0
SUBTOTAL	63787	4085	923	435	28003	7326	0	0	0
5/1---5/7	11569	4089	590	213	11049	2330	0	0	0
5/1---5/7	11569	4102	593	213	ll096	2339	0	0	0
5/1---5/7	14089	4997	721	261	13517	2849	0	0	0
5/8--5/14	5892	2638	391	248	7571	1222	1230	0	0
5/8--5/14	5625	2516	372	236	7236	1172	1174	0	0
5/8--5/14	6939	3096	458	290	a922	1443	1449	0	0
5/15-5/21	25816	7914	662	998	10577	1807	6102	0	0
5/15-5/21	17384	5300	468	678	7522	1339	4104	0	0
5/15-5/21	31957	9785	814	1233	13048	2216	7557	0	0
5/22-5/31	17279	2858	115	389	5531	180	10617	0	0
5/22-5/31	9959	1526	59	207	3069	101	6120	0	0
5/22-5/31	22632	3948	161	537	7414	239	13907	0	0
SUBTOTAL	60556	17499	1758	1848	34728	5539	17949	0	0
SUBTOTAL	44537	13444	1492	1334	28923	4951	11398	0	0
SUBTOTAL	75617	21826	2154	2321	42901	6747	22913	0	0

Table 13 (cont.)..Outmigration for 1984, Prosser trap
Upper frgure is logistic estimate
Lower figures are approximately 90% confidence interval

Dates	Wild spring chinook	Hatch. spring chrnook	Pond'84 chinook smolts (brands)	Truck'84 chinook smolts (brands)	Wild steelhead	Batch. steelhead	Wild fall chinook	Hatch. fall chinook	June'84 chinook fry
6/1---6/7	2869	369	13	19	1948	143	5216	0	0
6/1---6/7	1743	218	a	11	1157	94	3141	0	0
6/1---6/7	3872	505	19	25	2644	la3	7068	0	0
6/8--6/14	926	19	0	7	295	0	4824	0	0
6/8--6/14	438	9	0	3	135	0	2290	0	0
6/8--6/14	1635	41	0	la	584	0	8498	0	0
6/15-6/21	675	5	0	0	210	27	2093	22	0
6/15-6/21	307	2	0	0	98	10	954	7	0
6/15-6/21	919	6	0	0	306	35	2844	27	0
6/22-6/30	30	0	0	0	0	0	1566	1723	622
6/22-6/30	10	0	0	0	0	0	380	497	la4
6/22-6/30	68	0	0	0	0	0	1326	1315	455
SUBTOTAL	4500	393	13	26	2453	170	13699	1745	622
SUBTOTAL	2498	229	8	14	1390	104	6765	504	la4
SUBTOATL	6494	552	19	43	3534	218	19736	I.342	455
l/l-l/l	0	0	0	0	86	0	920	21377	9333
7/1---7/7	0	0	0	0	54	0	471	14191	5609
7/1---7/7	0	0	0	0	116	0	1574	32584	13829
7/8--7/14	0	0	0	0	6	0	440	6004	2035
7/a-7/14	0	0	0	0	6	0	418	5688	1944
7/8--7/14	0	0	0	0	7	0	498	6724	2334
7/15-7/21	0	0	0	0	2	0	210	2520	1147
7/15-7/21	0	0	0	0	2	0	202	2413	1101
7/15-7/21	0	0	0	0	2	0	241	2883	1333
7/22-7/31	0	0	0	0	0	0	109	600	567
7/22-7/31	0	0	0	0	0	0	106	578	546
7/22-7/31	0	0	0	0	0	0	131	714	668
SUBTOTAL	0	0	0	0	94	0	1679	30501	13082
SUBTOTAL	0	0	0	0	62	0	1197	22870	9200
SUBTOTAL	0	0	0	0	125	0	2444	42905	18164
SEASON	119520	21212	2522	2227	63205	11648	33327	32246	13704
SEASON	97161	16899	2231	1692	53464	10756	19360	23374	9384
SEASON	151647	26463	3096	2799	80979	14291	45093	44247	la619

Table 14. Outmigration for 1983, Prosser trap
Upper figures is logistic estimate
Lover figures are approximate 90% confidence interval

Dates	Wild spring chrnook	Hatch. spring chrnook	Pond'84 chinook smolts (brands)	Truck'84 chinook smolts (brands)	Wild steelhead	Hatch. steelhead	Wild fall chinook
4/4—-4/7	6816	0	0	0	2500	0	0
4/4—-4/7	3309	0	0	0	1168	0	0
4/4—-4/7	11247	0	0	0	4493	0	0
4/8—4/14	6062	0	0	0	1665	0	0
4/8—4/14	3751	0	0	0	1040	0	0
4/8—4/14	7589	0	0	0	2072	0	0
4/15-4/21	35518	0	0	0	5621	321	81
4/15-4/21	22976	0	0	0	3491	207	50
4/15-4/21	45193	0	0	0	7308	397	99
4/22-4/30	42365	9806	593	155	14887	1526	2006
4/22-4/30	17055	4231	263	67	5930	633	a49
4/22-4/30	126140	20089	1074	272	41189	4153	4701
SUBTOTAL	90761	9806	593	155	24673	1847	2087
SUBTOTAL	47091	4231	263	67	11629	840	899
SUBTOTAL	190169	20089	1074	272	55062	4550	4800
5/1—-5/7	20169	47688	2737	784	9628	3411	11311
5/1—-5/7	8801	20846	1197	340	4178	1469	4871
5/1—-5/7	37907	90189	5265	1495	18240	6628	21644
5/8—5/14	9198	14536	390	419	7157	3375	14237
5/8—5/14	4115	6485	161	191	3182	1531	6684
5/8—5/14	19679	30488	811	773	16187	6605	27805
5/15-5/21	6237	7947	89	292	7432	1539	14496
5/15-5/21	4640	5776	65	210	5484	1142	10903
5/15-5/21	7529	9604	105	350	8975	la55	17517
5/22-5/31	6230	4147	52	110	6624	1581	16227
5/22-5/31	3023	2354	34	69	3513	886	7066
5/22-5/31	9009	6054	66	147	9614	2264	21137
SUBTOTAL	41834	74318	3268	1605	30841	9906	56271
SUBTOTAL	20579	35461	1457	810	16357	5028	29524
SUBTOTAL	74124	136335	6247	2765	53016	17352	88103

Table 14 (cont.). Outmigration for 1983, Prosser trap
Upper figures is logistic estimate
Lower figures are approximate 90% confidence interval

Dates	Wild spring chinook	Hatch. spring chinook	Pond chinook smolts (brands)	'84 Tr chinook smolts (brands)	Wild steelhead	Hatch. steelhead	Wild fall chinook
6/1—6/7	1718	221	18	0	701	53	12214
6/1—6/7	440	48	4	0	175	15	3090
6/1—6/7	1612	150	12	0	675	60	11358
6/8—6/14	782	42	0	0	625	23	7800
6/8—6/14	384	22	0	0	311	I.3	3814
6/8—6/14	1330	61	0	0	1029	29	13274
6/15-6/21	370	29	2	0	288	32	7648
6/15-6/21	317	23	2	0	228	26	6538
6/15-6/21	455	34	2	0	357	38	9480
6/22-6/30	a3	0	0	0	35	1	1876
6/22-6/30	79	0	0	0	34	1	1763
6/22-6/30	91	0	0	0	37	1	2106
SUBTOTAL	2953	292	20	0	1649	109	29538
SUBTOTAL	1220	93	6	0	748	55	15205
SUBTOTAL	3488	245	14	0	2098	128	36218
7/1—7/7	0	0	0	0	9	0	912
7/1—7/7	0	0	0	0	9	0	915
7/1—7/7	0	0	0	0	10	0	1113
7/8—7/14	0	0	0	0	1	0	293
7/8—7/14	0	0	0	0	1	0	277
7/8—7/14	0	0	0	0	1	0	338
7/15-7/21	0	0	0	0	0	0	62
7/15-7/21	0	0	0	0	0	0	58
7/15-7/21	0	0	0	0	0	0	70
7/22-7/31	0	0	0	0	0	0	125
7/22-7/31	0	0	0	0	0	0	115
7/22-7/31	0	0	0	0	0	0	137
SUBTOTAL	0	0	0	0	10	0	1392
SUBTOTAL	0	0	0	0	10	0	1365
SUBTOTAL	0	0	0	0	11	0	1658
SEASON	135548	a4416	3881	1760	57173	11862	89288
SEASON	68890	39785	1726	a77	28144	5923	46993
SEASON	267781	156669	7335	3037	110187	22030	130779

Total 1985 outmigration of wild spring chinook, wild fall chinook and wild steelhcad was estimated at 82,567, 59,191, and 55,589, respectively (Tables 12, 13 and 14 summarize weekly passage in 1983, 1934 and 1985, respectively, while Appendix B lists the daily estimated outmigration and approximate confidence intervals for 1983-1985). Conparable figures for 1984 are 119,520, 33,329 and 63,205, while those for 1983 are 135,548, 89,285 and 57,173 (Table 15).

Table 15. Estimated outmigration of wild salmonids at Prosser Dam in 1983, 1984 and 1985.

Year	Wild Spring Chinook	Wild Fall Chinook	Wild Steelhead
1983	135,54S	89,288	57,173
1984	119,520	33,327	63,205
1985	82,567	59,191	55,589

These estimates demonstrate that the outnigration of spring chinook and, in a more erratic manner, fall chinook have been declining, while the outmigration of steelhead has been relatively constant. The consistent decline in wild spring chinook smolt outmigration is of particular interest. Some decline in 1985 passage relative to 1984 and

1983 was expected because the brood year escapement that produced the 1985 smolts was relatively lower (see “Estimate of survival through various iife stages.") However, survival from egg to smolt has also dropped consistently over the past few years, being estinated at 6.4 percent in 1963, 4.7 percent in 1984 and 4.4 percent in 1985.

The explanation for this decline in survival from egg to smolt is presently unclear. Two compatable hypotheses are currently being considered. The first entails increased mortalities during years of low spring river flows, and the second entails a variable fall-winter pre-snolt outmigration. It is plausible that low spring river flows might play a role in reduced egg-to-smolt survival over the past three years. Discharge in the mid-reaches of the Yakixa River during the peak peroid of the smolt run has steadily declined from 1983 to 1985 (Table 16 and Figure 6) , and the drop during the drought of 1985 was especially pronounced. Low flows might reduce smolt survival in two major ways: by retarding migration rate and prolonging the period of vulnerablility to riverine predators, and/or simply by eliminating the depth and frequency of pools and other deep-water refuges and thereby concentrating predators and prey in space.

Alternatively it is conceivable that the apparent decline in egg-to-smolt survival rates is merely the result of an unmeasured, variable outmigration of pre-snolts in the winter. As mentioned, an unexpedted number of chinook and steelhead juvenile entered Chandler Canal in January and February of 1985.

Table 16. Mean monthly discharge in middle reaches of the Yakima River during the spring and early summer of 1983, 1984 and 1985.

River section and Year		March mean discharge (cfs)	April mean discharge (cfs)	May mean discharge (cfs)	June mean discharge (cfs)	July mean discharge (cfs)
Yakima Canyon	1983	3,448	3,339	4,752	3,641	3,267
(RM 140.4)	1984	2,673	2,499	3,974	5,775	3,634
	1985	1,182	2,993	2,834	3,146	4,766
Parker	1983	6,671	4,092	5,442	3,404	623
(RM 103.7)	1984	4,248	2,139	2,969	6,119	883
	1985	1,696	2,774	1,293	991	378
Prosser	1983	9,488	6,163	6,990	5,542	2,314
(RM 47.1)	1984	5,036	3,690	4,172	6,963	2,496
	1985	2,224	3,776	2,602	2,397	1,462

1. Total discharge approaching dam = (Yakima R. below dam) + (Chandler Canal)

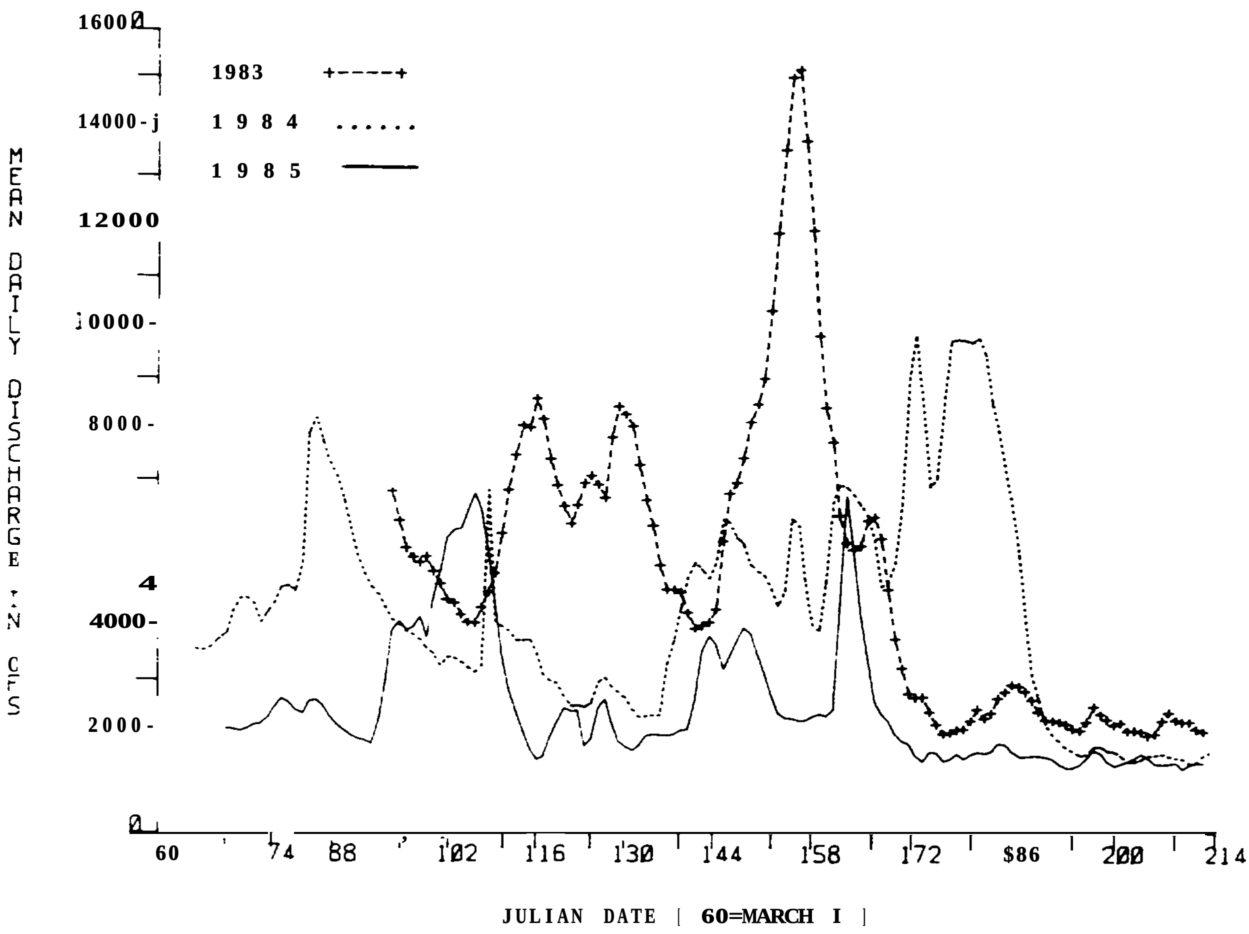


Figure 6. Mean daily discharge in Yakima River immediately above Prosser Dam during smolt-trapping period in 1983, 1984, and 1985.

Futhermore, approximately 59,500 spring chinook migrated out of the Naches River in September, October and November of 1985 (see "Wapatox Smolt trap."). Such a fall outmigration of pre-smolts from Yakina tributaries may be a normal phenomenon, as it is in tributaries of the Salmon River in Idaho (Bjornn, 1971). Tne possibility exits that extremely cold winters and the stressful conditions they entail (anchor ice, ice jams, and so on) might force juvenile salmonids to outmigrate from the mid-regions of the Yakima River, where they would normally overwinter, to the lower river and possibly all the way to the Columbia.

As ment ioned the evidence for either explanation is not conclusive at this point, al though the "low flow/retarded migration: hypothesis has some corroboration. As figures 7 through 21 demonstrate, more smolts move on a rising river. The effect of increasing discharge is particularly evident when the rise follows a period of relatively low flows, as happened frequently in 1984 and 1985. Conversely, as is evident in some of the data for 1983, a rise in discharge has little effect on outmigration when it occurs at a tine when flows are high al ready.

The importance of river flow to effective outmigration was illustrated by an incident that occurred in 1385. Beginning April 16, discharge in the Yakima River at Prosser began a steady, nine-day decline, from approximately 1,300 cfs on April 16 to about 1000 cfs on April 24.

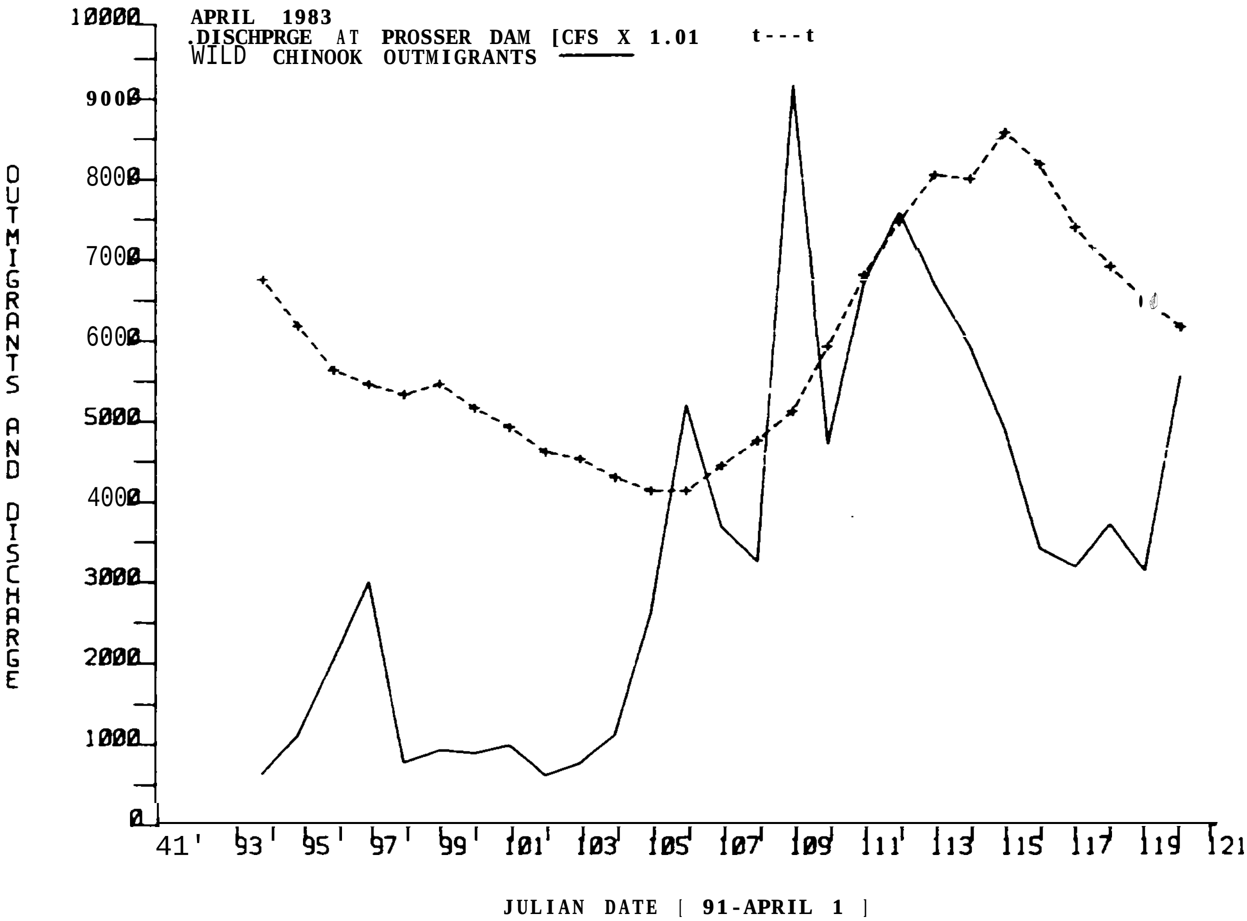


Figure 7. Mean daily discharge at Prosser Dam and estimated outmigration of wild chinook smolts during April 1983.

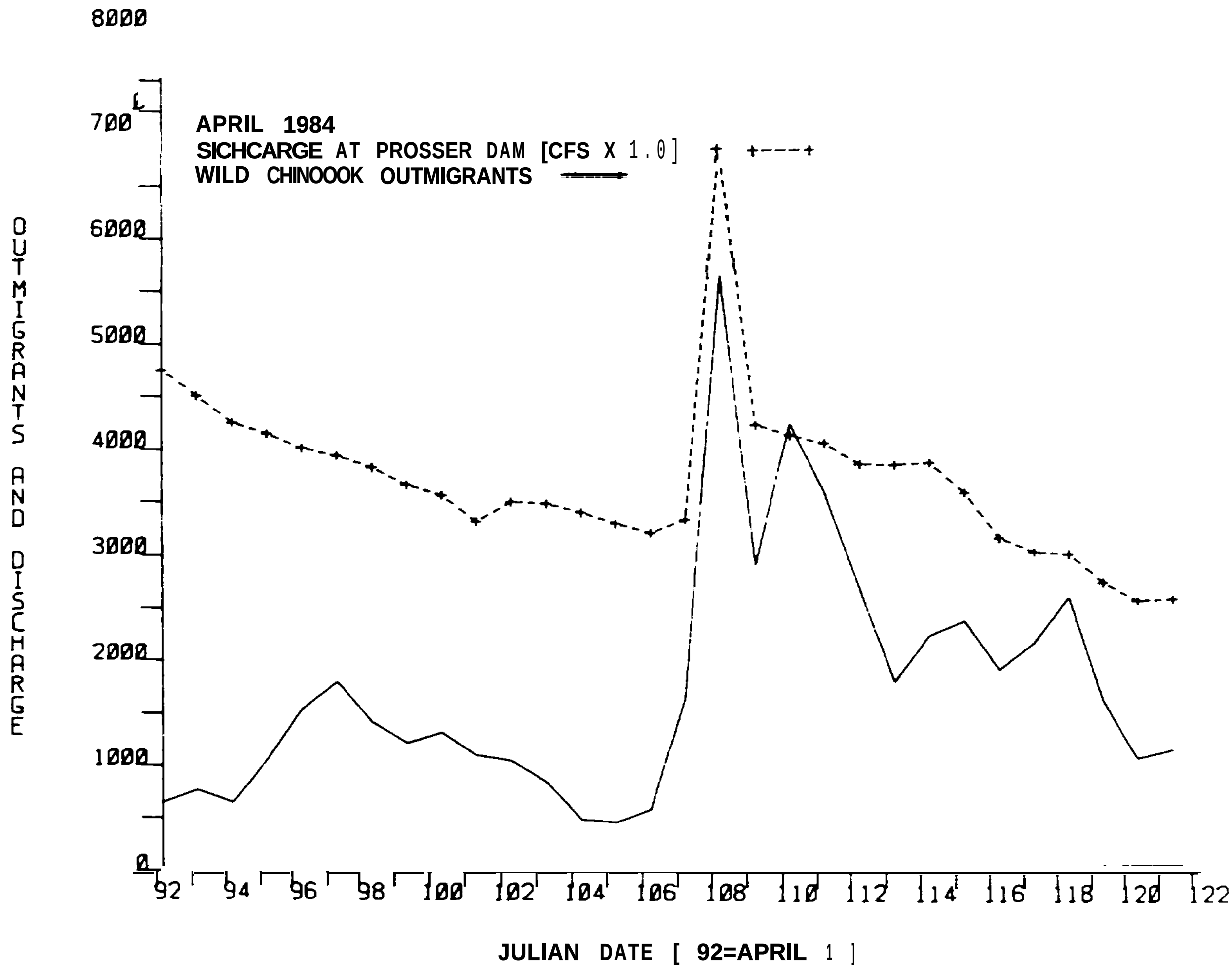


Figure 8. Mean daily discharge at Prosser Dam and estimated outmigration of wild chinook smolts during April 1984.

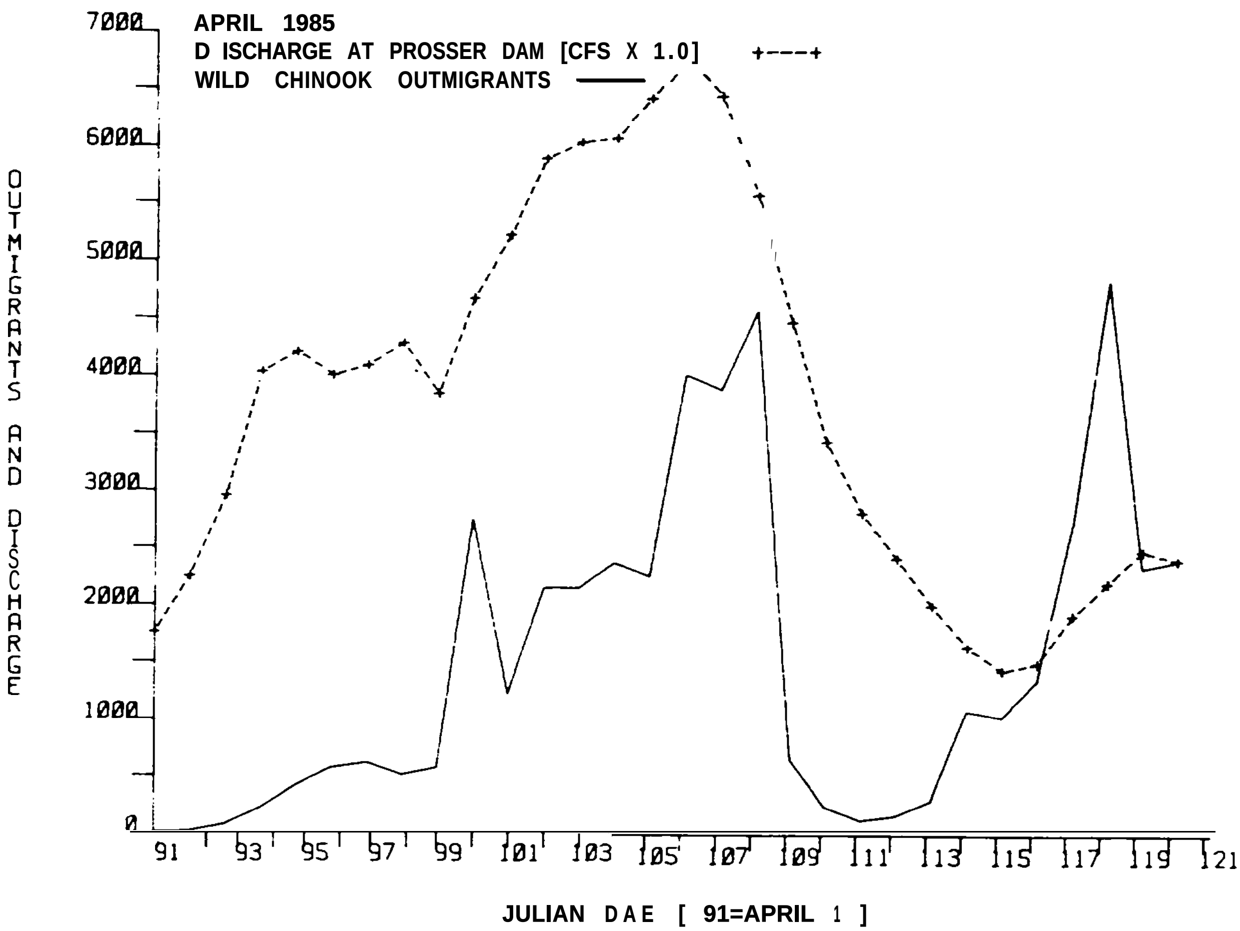


Figure 9. Mean daily discharge at Prosser Dam and estimated outmigration of wild chinook smolts during April 1985.

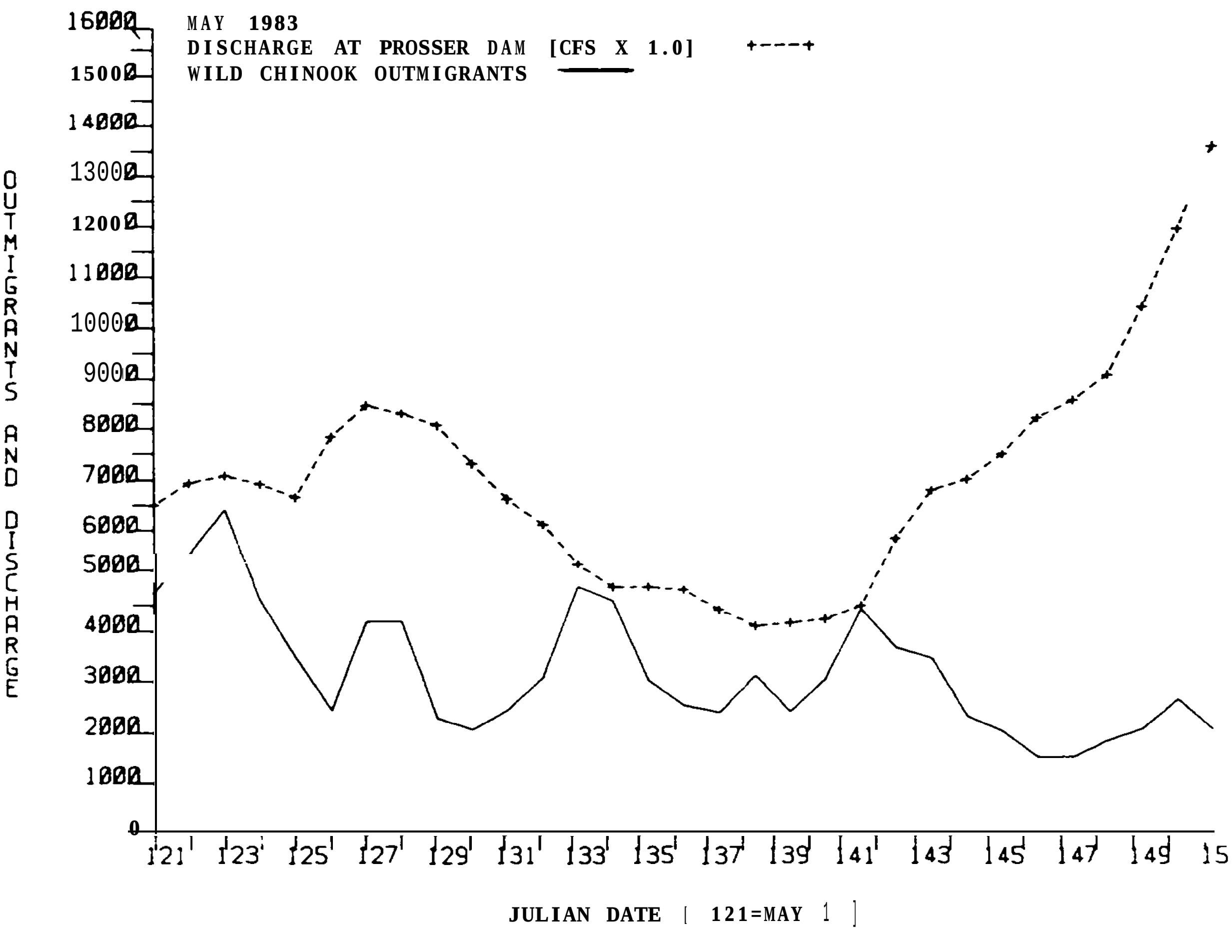


Figure 10. Mean daily discharge at Prosser Dam and estimated outmigration of wild chinook smolts during May 1983.

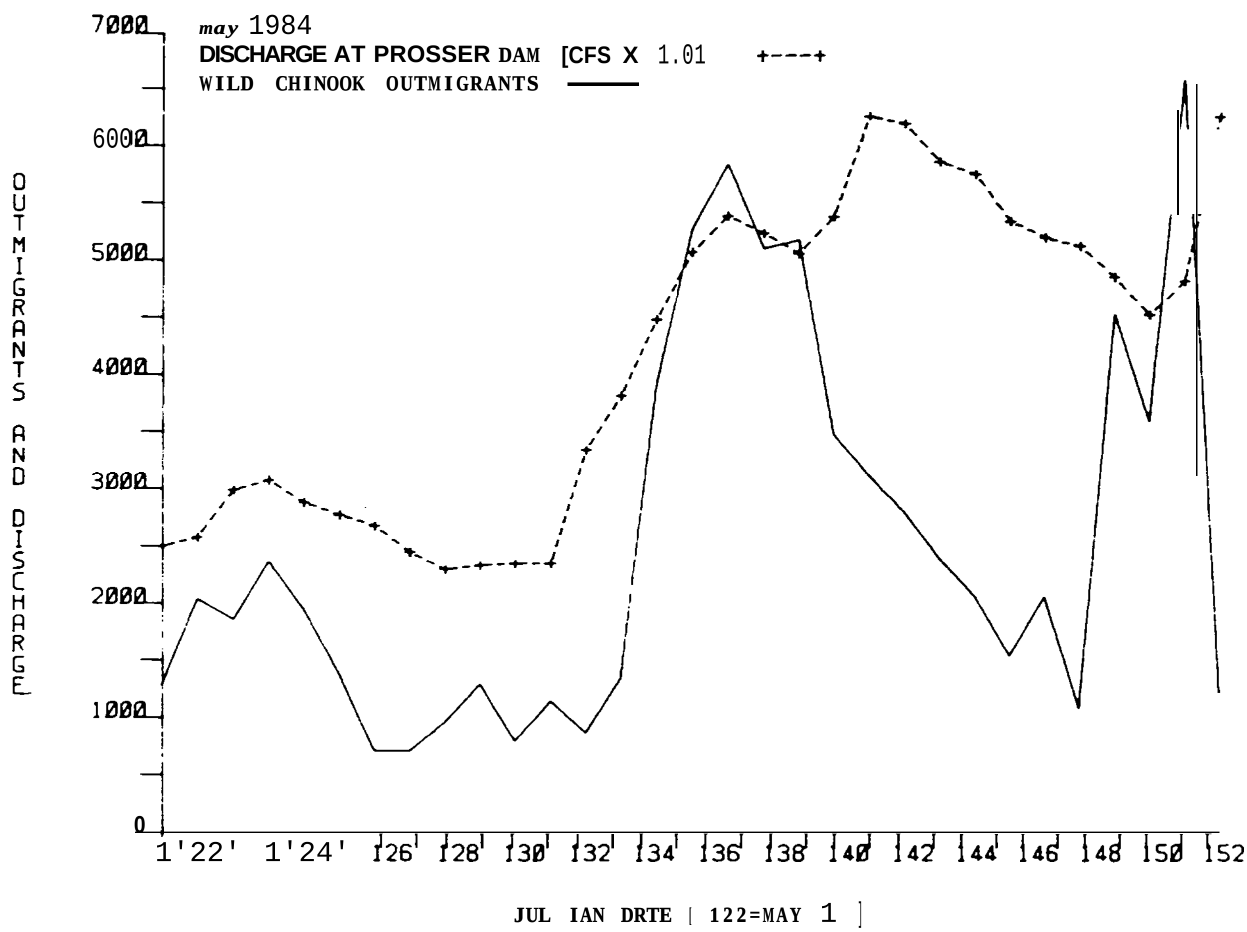


Figure 11. Mean daily discharge at Prosser Dam and estimated outmigration of wild chinook smolts during May 1984.

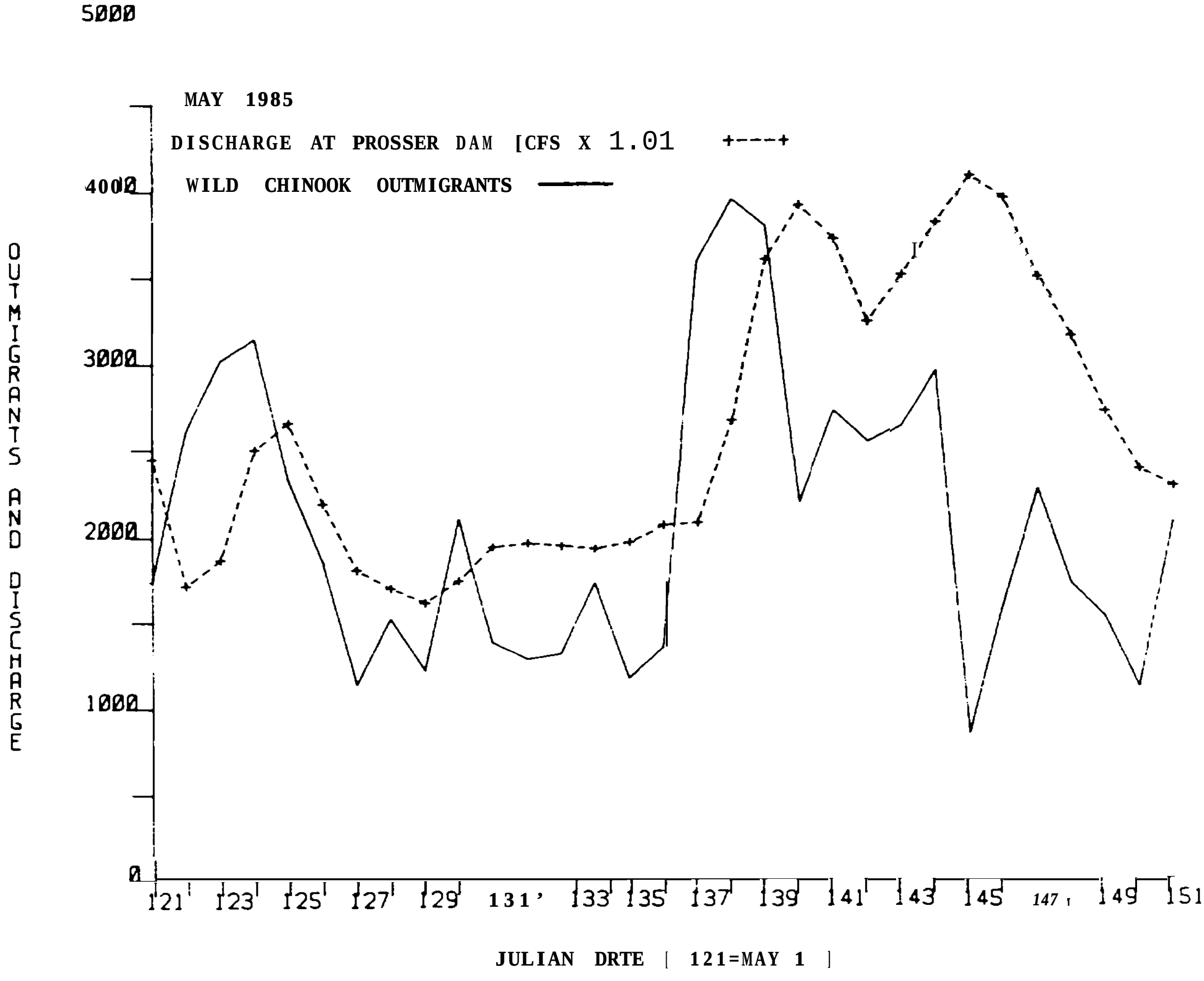


Figure 2. Mean daily discharge at Prosser Dam and estimated outaigration of wild chinook smolts during May 1985.

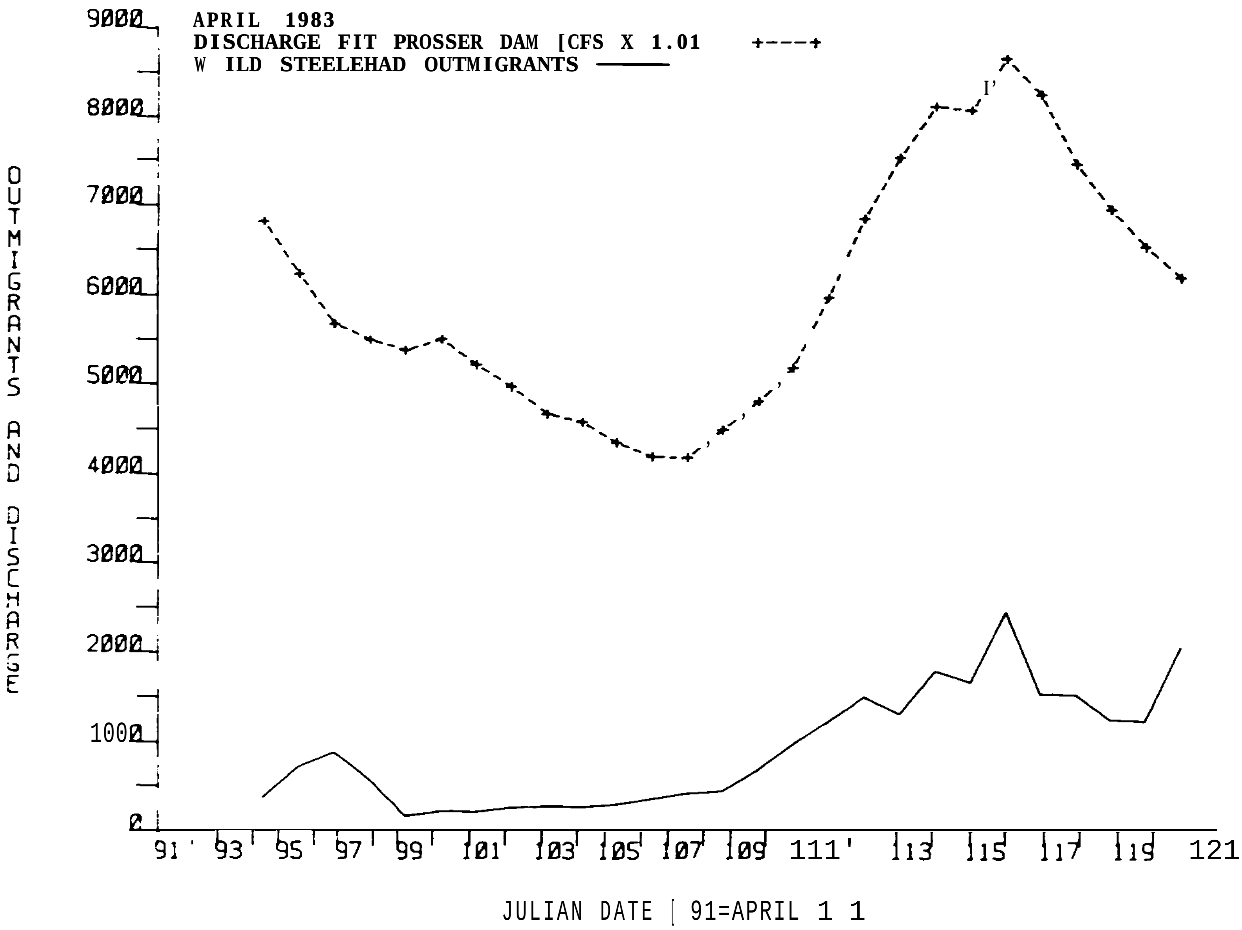


Figure 13. Mean daily discharge at Prosser Dam and estimated outmigration of wild steelhead smolts during April 1983.

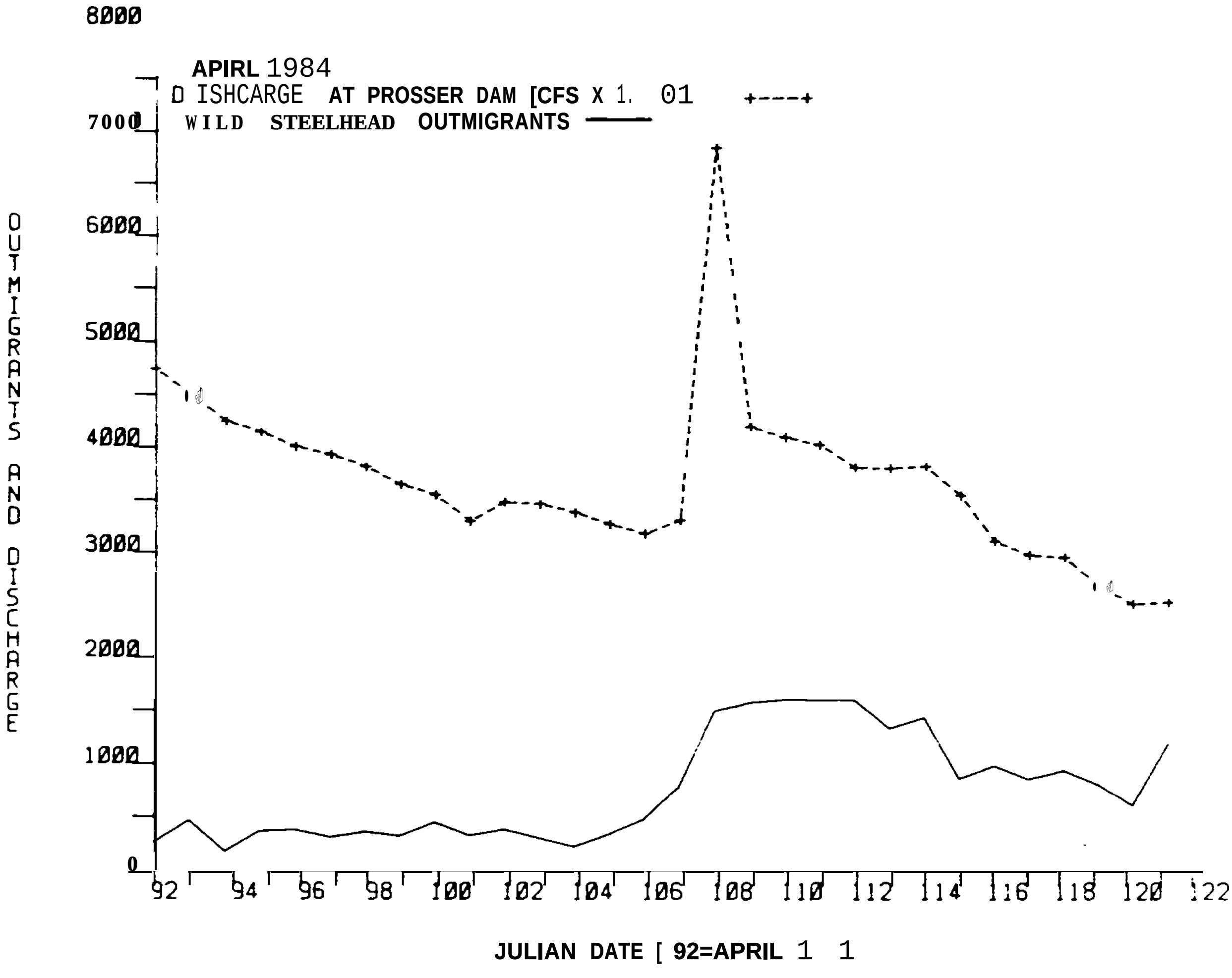


Figure 14. Mean daily discharge at Prosser Dam and estimated outmigration of wild steelhead smolts during April 1984.

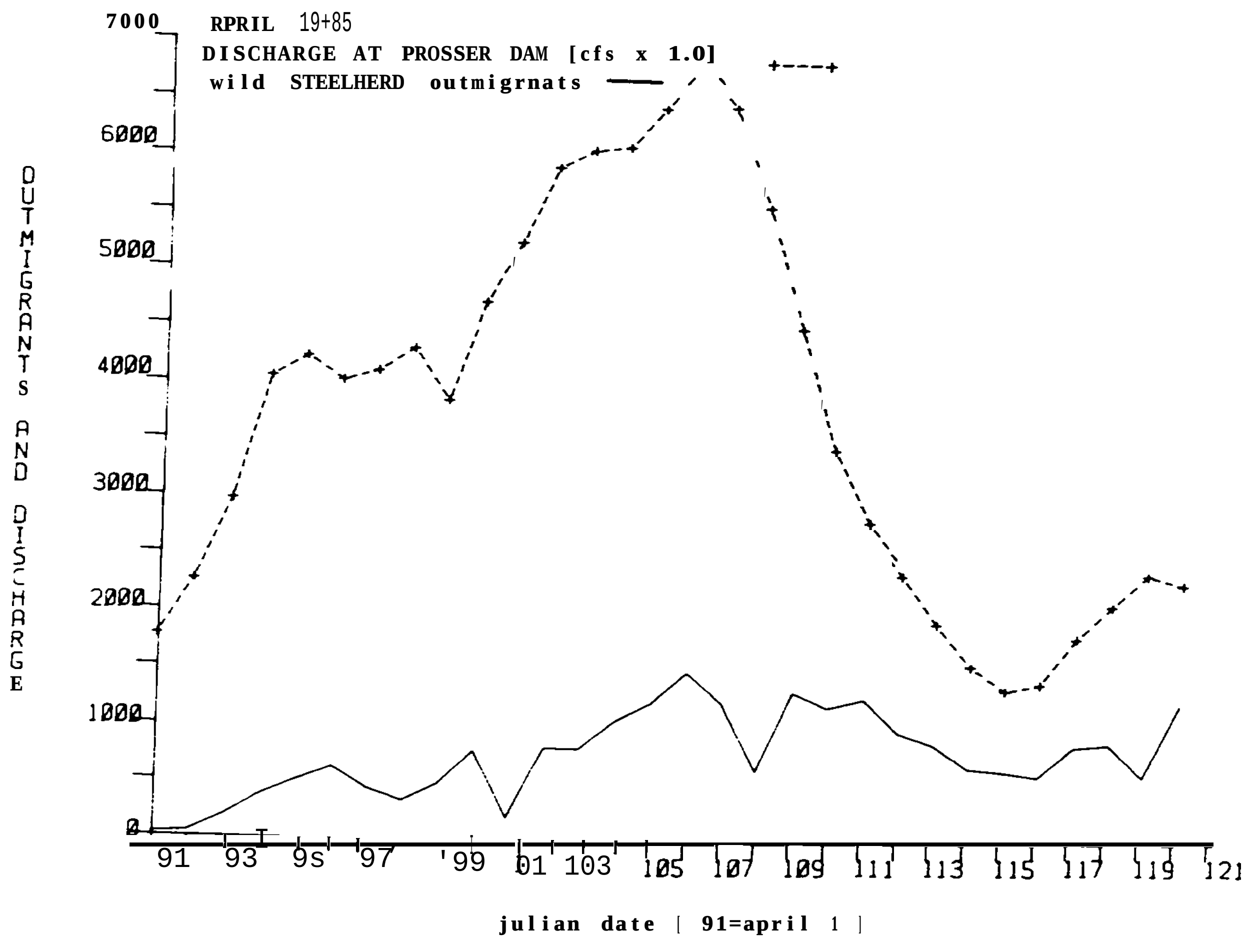


Figure 15. Mean daily discharge at Prosser Dam and estimated outmigration of wild steelhead smolts during April 1985.

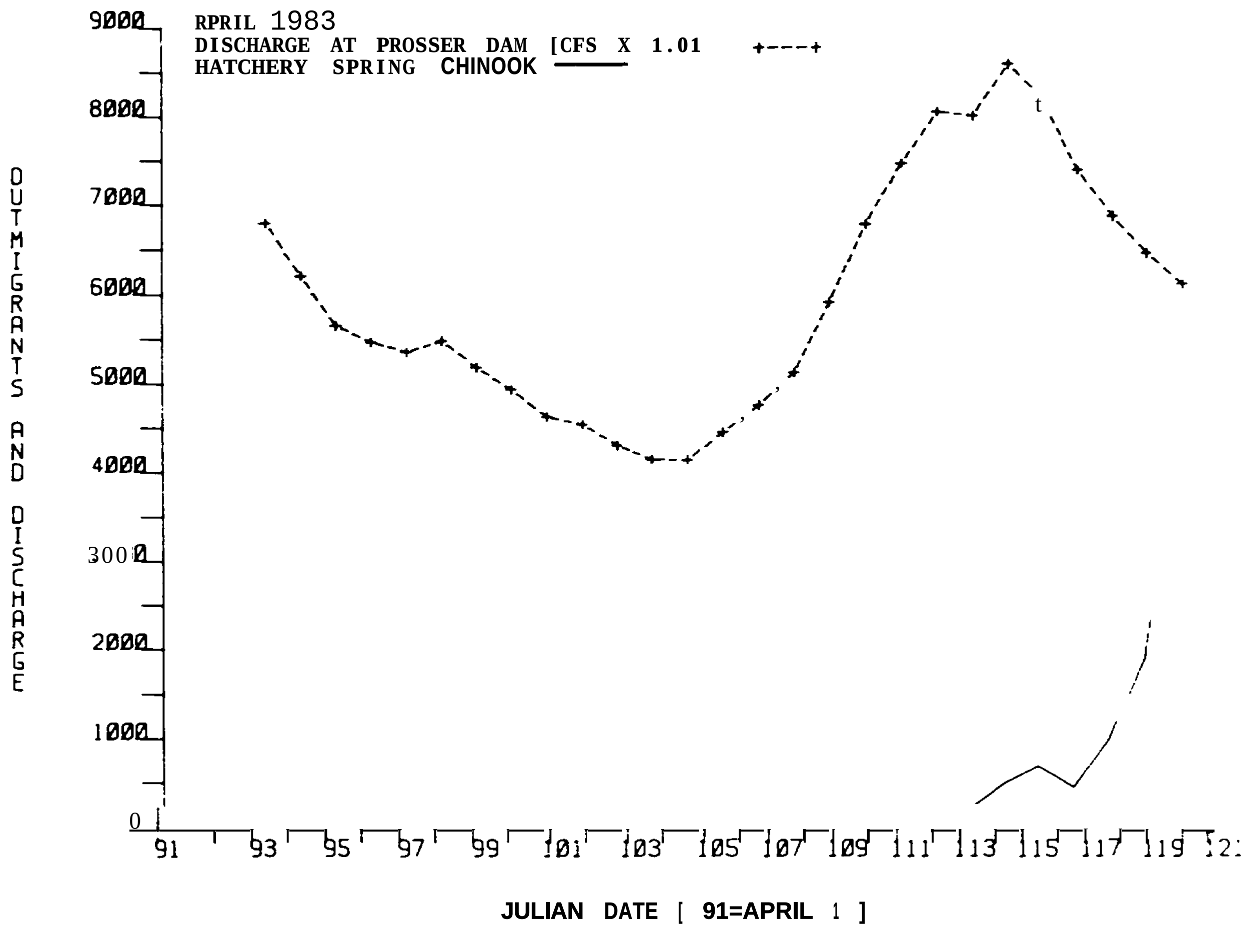


Figure 16. Mean daily discharge at Prosser Dam and estimated outmigration of hatchery spring chinook smolts during April 1983.

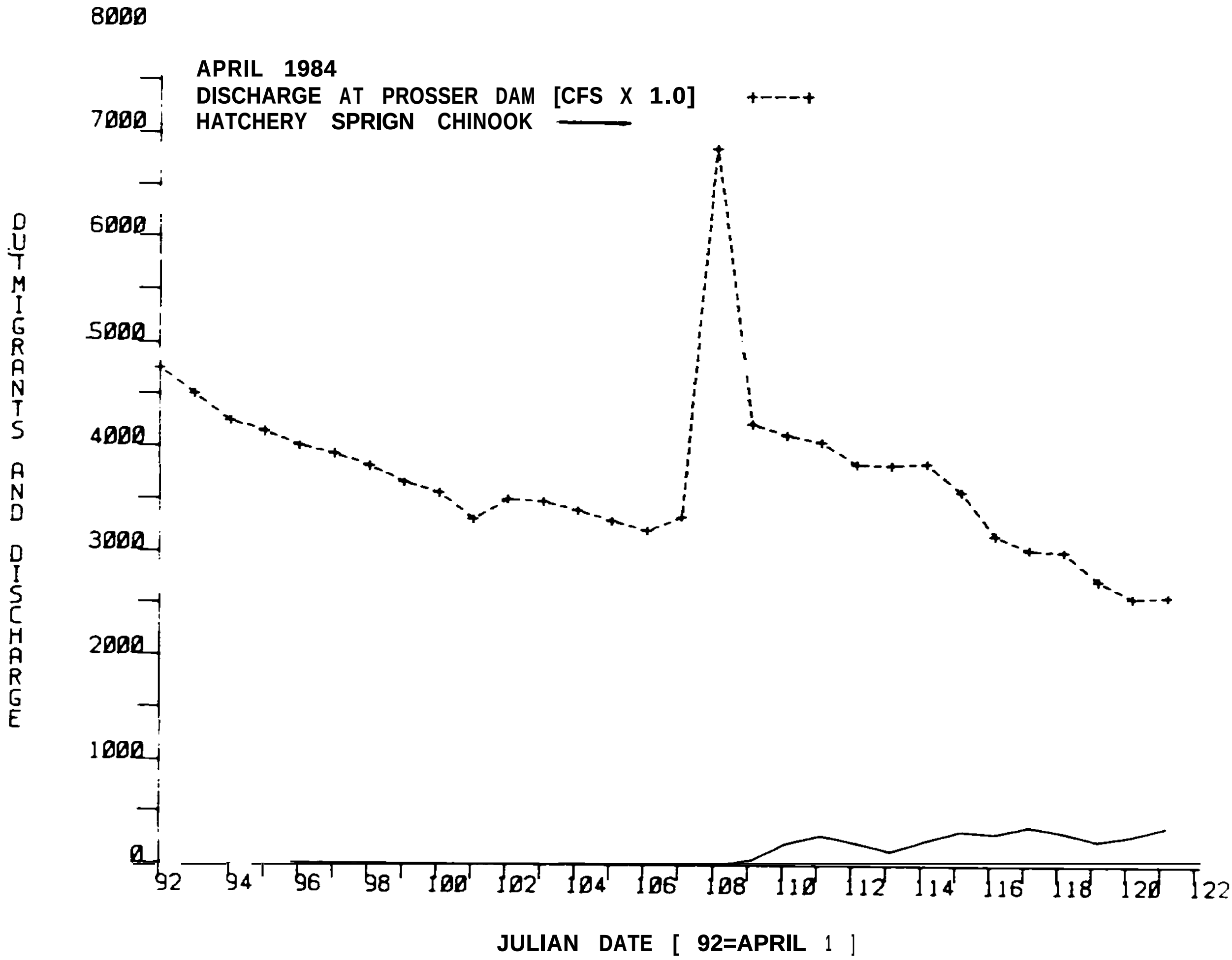


Figure 17. Mean daily discharge at Prosser Dam and estimated outmigration of hatchery spring chinook smolts during April 1984.

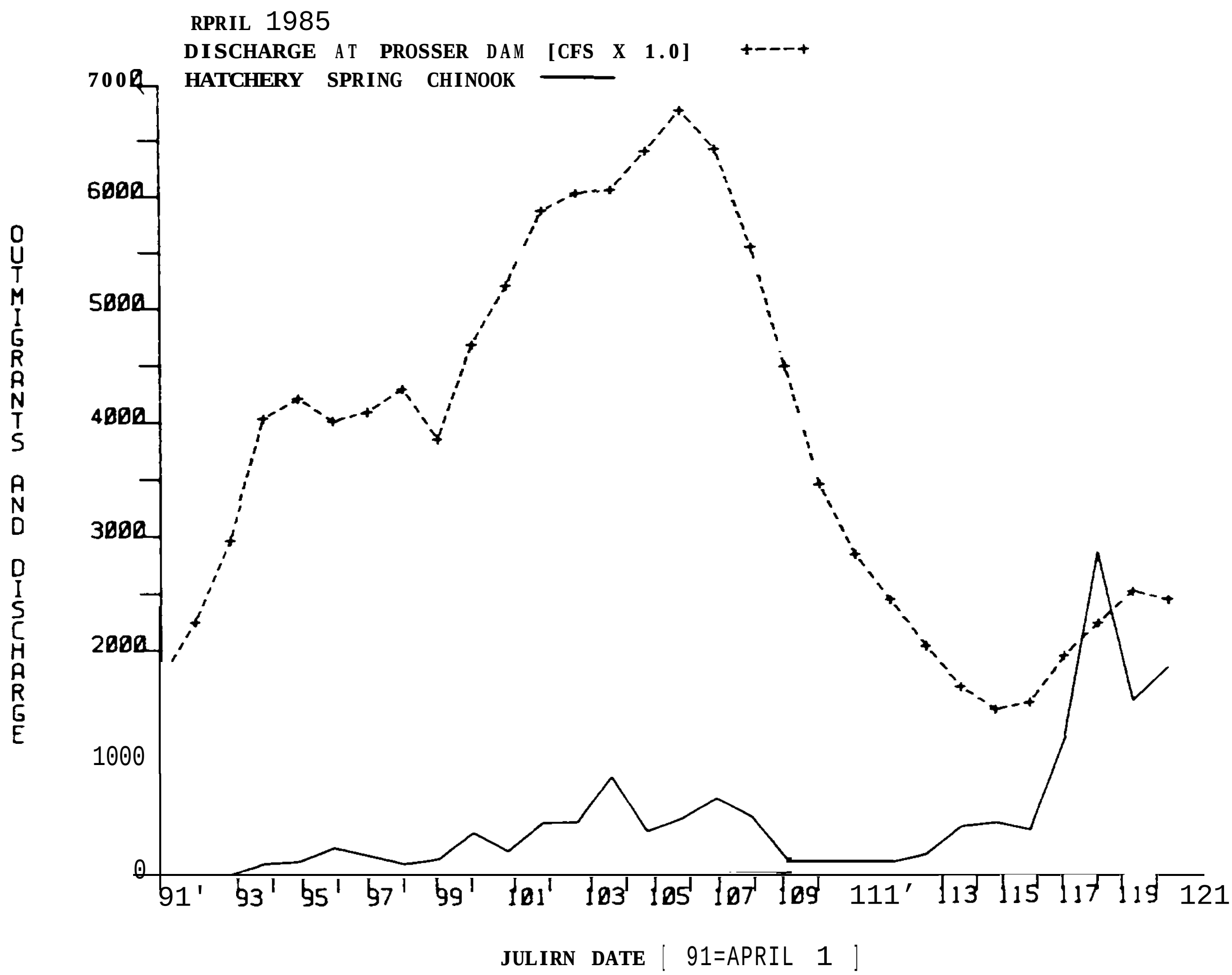


Figure 18. Mean daily discharge at Prosser Dam and estimated outmigration of hatchery spring chinook smolts during April 1985.

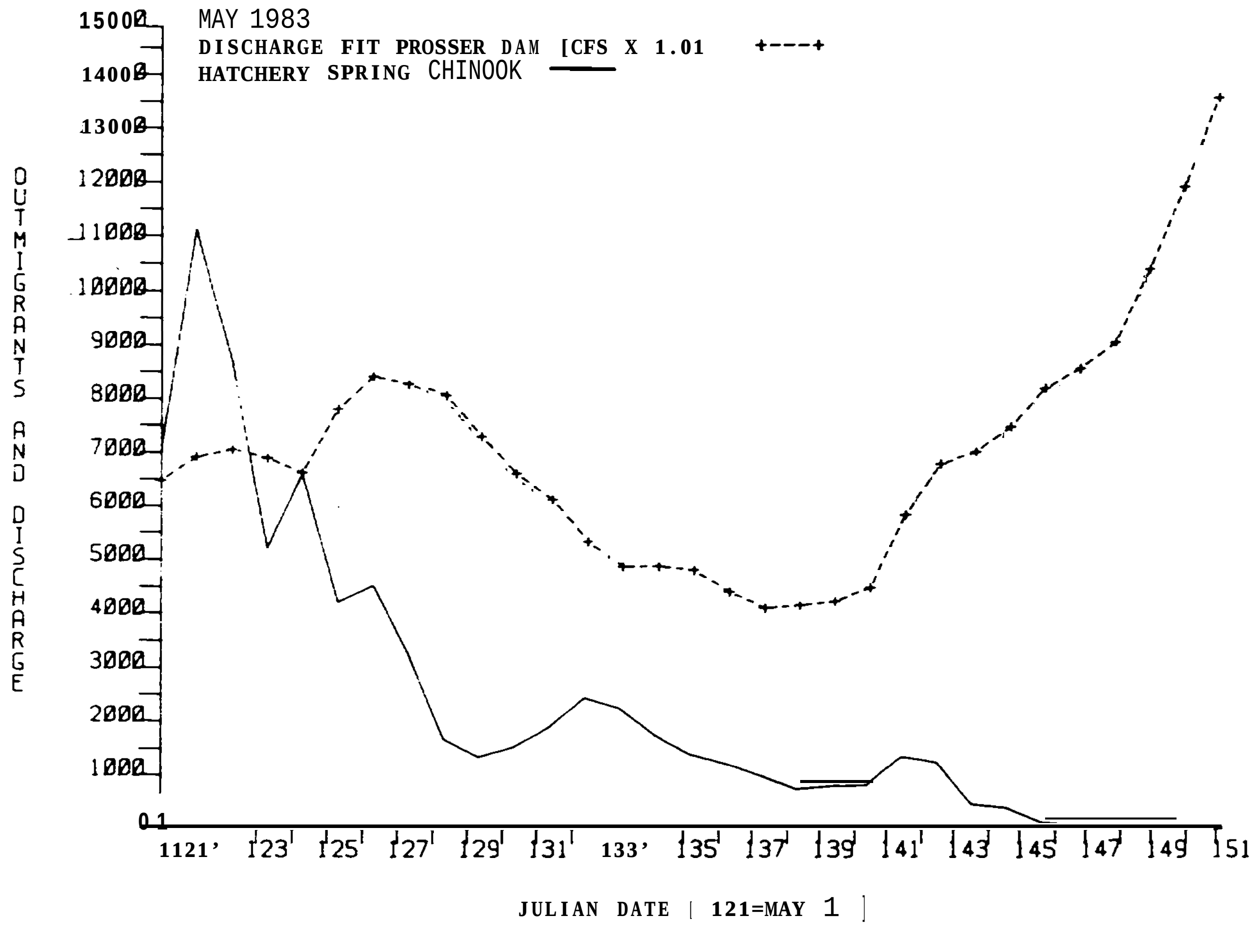


Figure 19. Mean daily discharge at Prosser Dam and estimated outmigration of hatchery spring chinook smolts during May 1983.

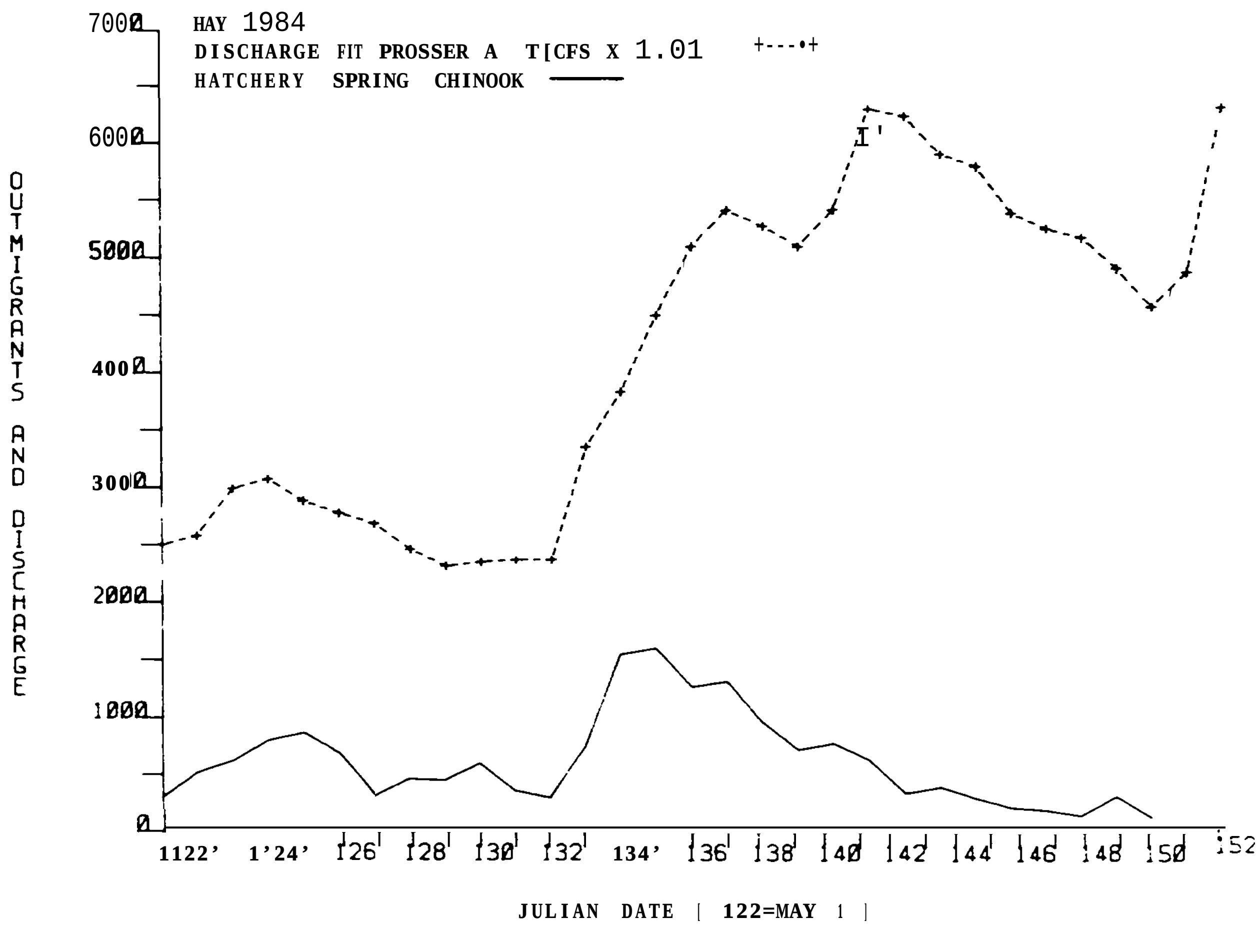


Figure 20. Mean daily discharge at Prosser Dam and estimated outmigration of hatchery spring chinook smolts during May 1984.

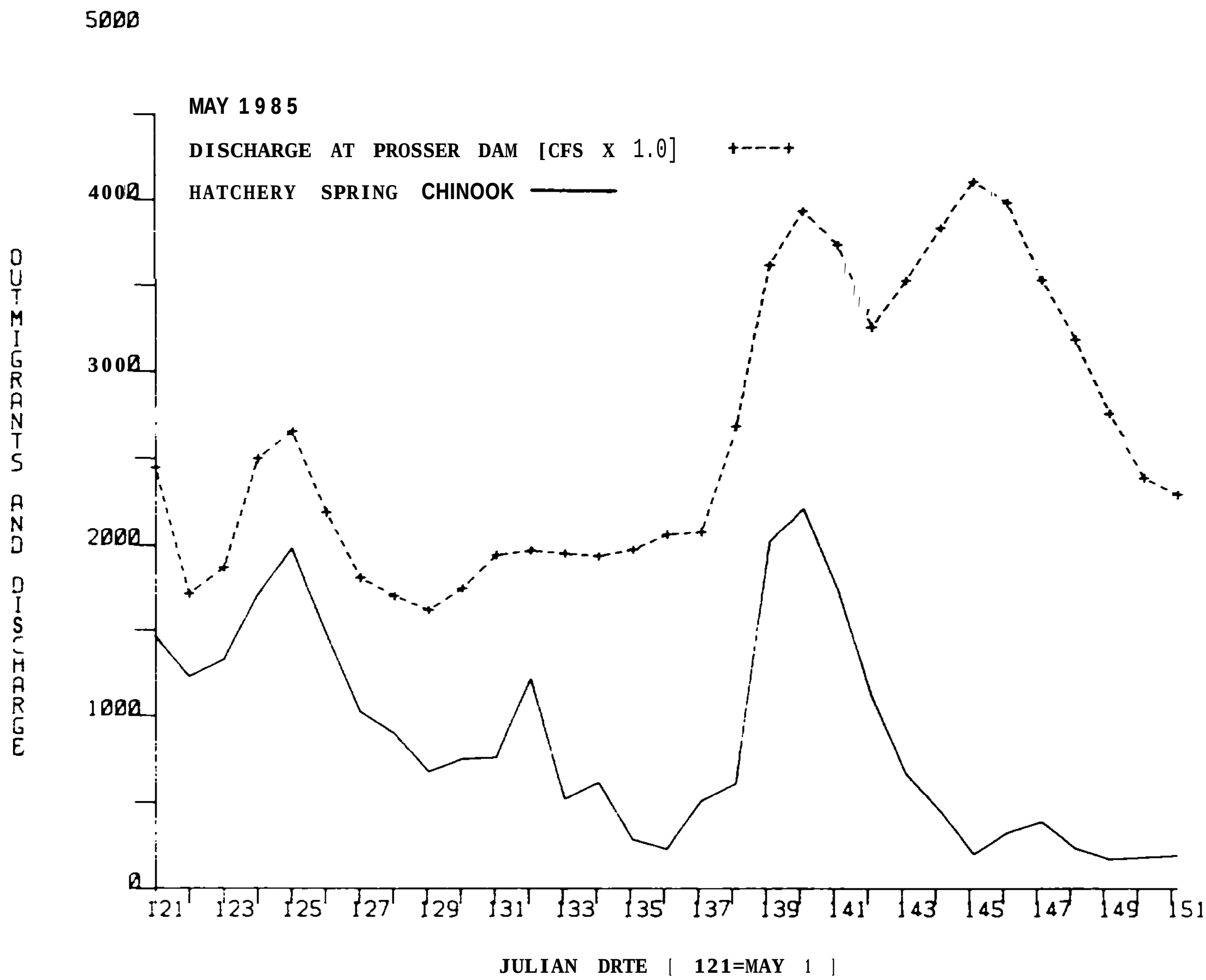


Figure 21. Mean daily discharge at Prosser Dam and estimated outmigration of hatchery spring chinook smolts during May 1985.

During this period, daily estimates of outmigrating spring chinook fell even nore precipitously, from a high of 4,041 on April 18 to a low of 120 on April 21. Biologists from Yakima Nation Fisheries Resource Management informed the Yakima District office of the Bureau of Reclamation that smolt outnigration had apparently stalled, and requested a brief release of water from storage reservoirs in an attempt to get the run moving again. The Bureau complied, and on April 25 an additional 1,350 cfs (850 cfs fron Cle Elum reservoir and 500 cfs from Rimrock Lake) was spilled into the river. Total spill was then cut back 368 cfs on April 28, and an additional 400 cfs the next day. The discharge surge created by the three-day spill apparently reached Prosser on April 26, and crested on April 29. During the surge in discharge the estimated number of wild chinook outnigracts increased nearly five-fold, from 998 on April 25 to 4,850 on April 28. The number of hatchery chinook outmigrnats during thistime increased more than six-fold, from 440 to 2,834. The total number of wild and hatchery chinook outmigrants on April 28 was 7,684, a modern record for a single day.

Consistant with the hypothesis that smolts are more disposed to move on high water, and that successful outmigration to some degree requires substantial flows during the peak of the smolt run in April and May, is the fact that the spring chinook smolt run was later in the low-flow years of 1984 and 1985 than it was in 1983, when spring flows were substantially higher.

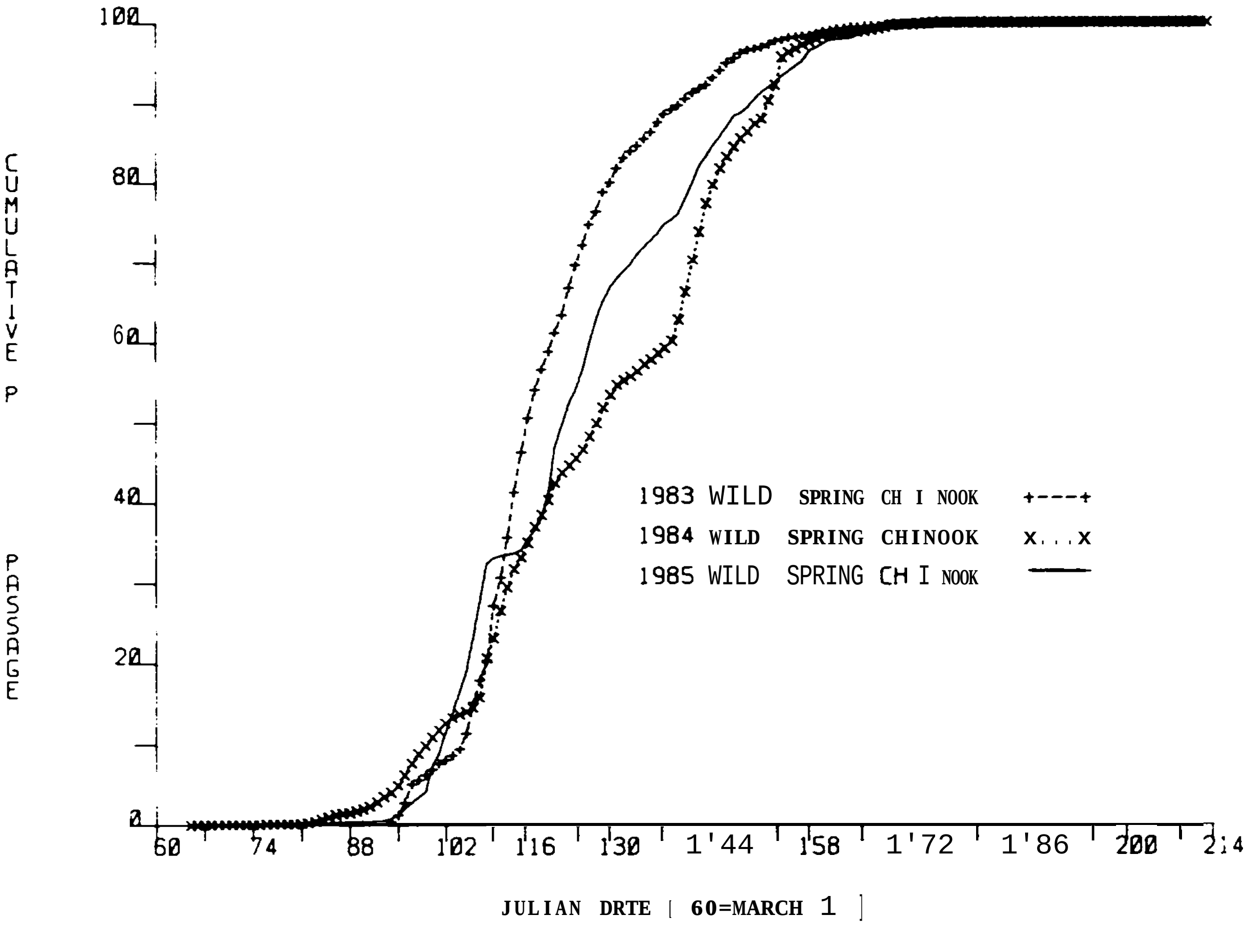


Figure 22. Cumulative percent passage of wild spring chinook smolts past Prosser Dam in 1983, 1984, and 1985.

A lag in migration timing is apparent in Figure 22, and is confirmed by a Kolmogorov-Smirnov test of the temporal distributions of cumulative passage. The distributions of both 1934 and 1985, adjusted for different starting dates, were significantly different (alpha = 0.05) from 1983. The figures summarized in Table 17 provide additional clarification. In 1983, 67 percent of the spring chinook smolt run passed Prosser in April, a month in which the mean discharge at Prosser Dam was 5,998 cfs. In April of 1984 and 1985, the monthly passage of spring chinook smolts was 43.2 and 52.1 percent, respectively, while the mean monthly discharge was 3,690 and 3,776 cfs. Thus, it would appear that higher April discharges result in a proportionatley greater monthly outmigration. In fact, the correlation coefficient between mean April discharge and percent passage in April for 1983 through 1985 is +0.94. If higher flows in April move the run through the river more rapidly, it would seem, by reducing the period of exposure to predators, they would also permit increased survival for the run as a whole.

There is some evidence tnat small fish are the principal beneficiaries of the benefits high spring flows confer on the spring chinook smolt run. The mean fork length of spring chinook snolts captured in April of 1983, 1984 and 1985 was 129.4, 133.1 and 139.1mm, respectively. If smaller, slower swimming fish are relatively more dependent upon high flows for rapid migration, then this size trend is compatible with the hypothesis of discharge-dependent smolt survival.

Table 17. Summary of wild chinok salmon and steelehad smolt outmigration and mean monthly discharge at Prosser Dam in 1983, 1984 and 1985.

		MARCH			APRIL			MAY			JUNE			JULY			Total seasonal
		Mean discharge (cfs)	Numbe of outmigrants	Percent seasonal outmigration	Mean discharge (cfs)	Number of outmigration	Percent seasonal outmigration	Mean discharge (cfs)	Number of outmigrants	Percent seasonal outmigraton	Mean discharge (cfs)	Number of outmigrants	Percent seasonal migration	Mean discharge (cfs)	Number of outmigrants	Percent seasonal migration	
1983	spring chinook	—	—	—	5,998	90,761	67.0	6,990	41,834	30.9	5,542	2,953	2.2	2,314	0	0	135,548
1983	fall chinook	—	—	—	5,998	2,007	2 3	6,990	56,271	63.0	5,542	29,538	33.1	2,314	1,392	1.6	89,288
1983	steelhead	—	—	—	5,998	24,673	43.2	6,990	30,841	53.9	5,542	1,649	2.9	2,314	10	0.02	57,173
1984	spring chinook	5,197	2,761	2.3	3,690	51,703	43.2	4,172	60,556	50.7	6,963	4,500	3.0	2,496	0	0	119,520
1984	fall chinook	5,197	0	0	3,690	0	0	4,172	17,949	53.8	6,963	13,699	41.1	2,496	1,679	5.0	33,327
1984	steelhead	5,197	3,220	5.1	3,690	22,710	35.9	4,172	34,720	54.9	6,963	2,453	3.9	2,496	94	0.1	63,205
1985	spring chinook	2,243	360	0.4	3,176	43,069	52.1	2,602	33,737	40.9	2,397	5,421	6.6	1,462	0	0	82,567
1985	fall chinook	2,243	0	0	3,716	2,808	4.7	2,602	30,721	51.9	2,397	25,124	42.4	1,462	538	0.1	59,191
1985	steelhead	2,243	496	0.1	3,776	23,838	42.9	2,602	28,282	50.9	2,397	2,954	5 3	1,462	19	0.03	55,589

During springs of low flow, smaller fish would lag behind their larger cohorts, and would suffer proportionately greater predatory losses.

Run Timing As mentioned, the timing of the spring chinook snolt runs in 1984 and 1985 was later than in 1983. The relative t iming may be further clarified by considering the dates of 50 and 75 percent passage as summarized in Table lg.

Table 18. Dates of 50 and 75 percent passage of wild spring chinook as counted at Prosser Dam in 1983, 1984 and 1985.

	Date of Passage	
Year	50%	752
1983	April 24	May 3
1984	May 3	May 18
1985	April 29	May 14

The run timing of the wild steelhead outmigration past Prosser is depicted in Figure 23. The degree of synchrony is highlighted in Table 19, which indicates that no more than 2 days separate the points of 50 or 75 percent passage over the past 3 years.

Table 19. Dates of 50 and 75 percent passage of wild steelhead smolts as counted at Prosser smolt trap in 1983, 1984 and 1985.

	Date of Passage	
Year	50%	75%
1983	May 2	May 15
1984	May 4	Nay 15
1985	May 3	May 17

The relative stability in magnitude and timing of the wild steelhead smolt run over tnree years of radically different flows is not necessarily inconsistant with the hypothesis presented in explanation of declining spring chinook runs. Yakima River steelhead smolts average 60 mm longer than spring chinook smolts, and are clearly much stronger swimmers. As such they may be much less dependent upon high river flows for timely and successful outmigrat ion.

The timing of wild fall chinook outmigration for the years 1983-1985 is depicted in Figure 24 and wummarized in Table 20.

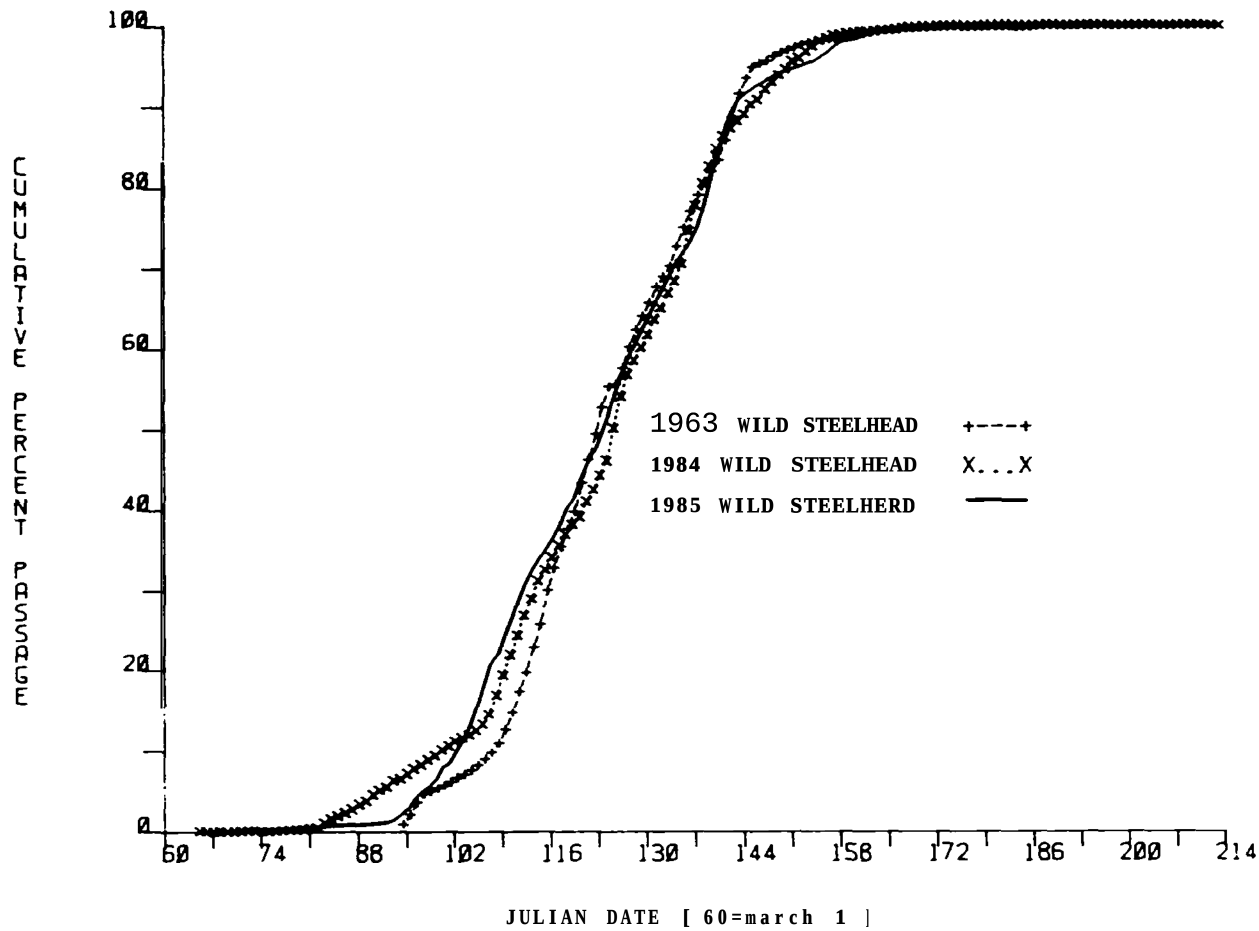


Figure 23. Cumulative percent passage of wild steelhead smolts past Prosser Dam in 1983, 1984, and 1985.

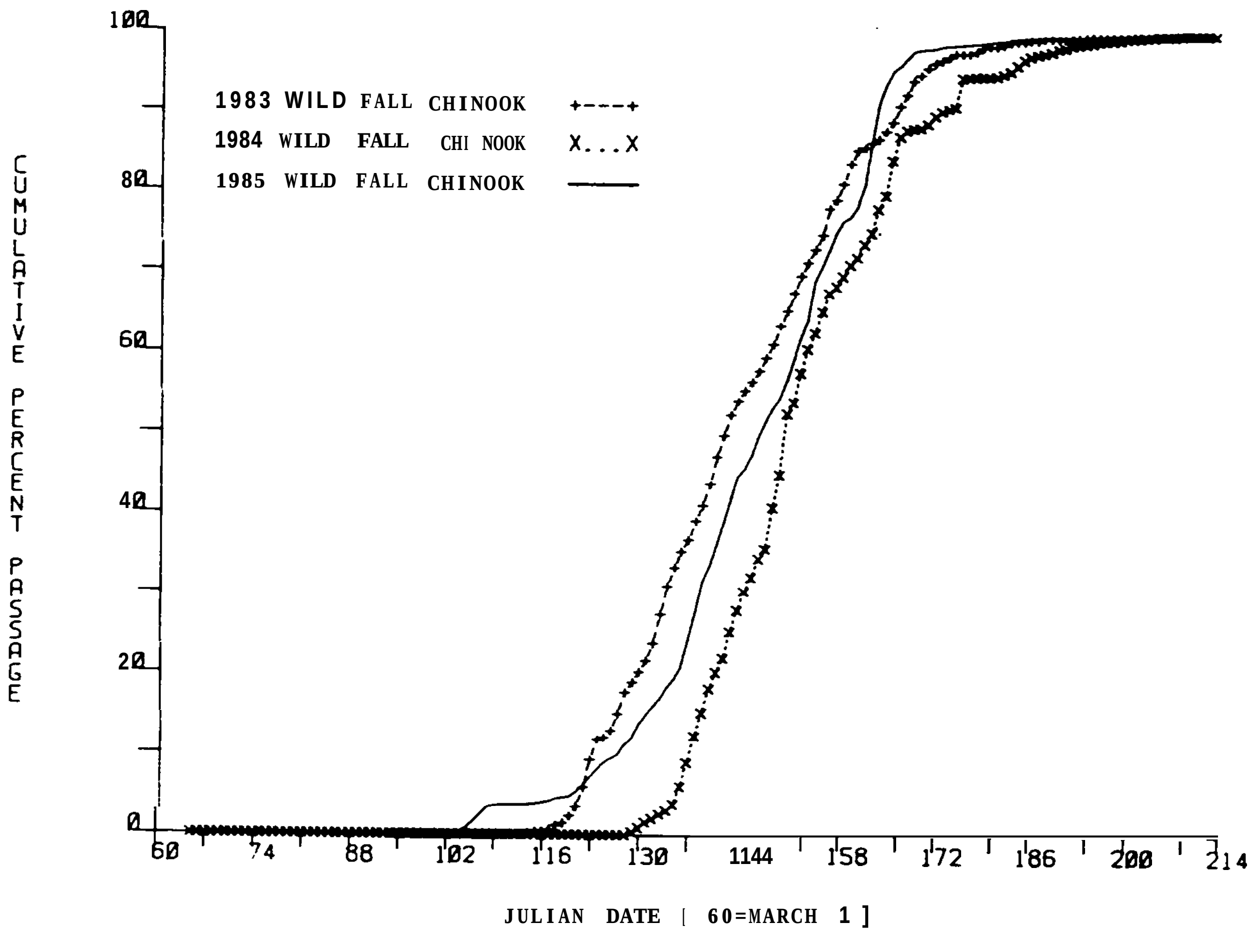


Figure 24. Cumulative percent passage of wild fall chinook smolts past Prosser Dam in 1983, 1984, and 1985.

Table 20. Dates of 50 **and** 75 passage of wild fall chinook caught at Prosser smolt trap in 1983, 1984 and 1985.

Year	Date of Passage 50%		Date of Passage 75%	
1983	May	22	June	5
1984	May	30	June	11
1985	May	27	June	7

Although the 1983 outmigration is clearly earlier than 1984 and 1985, while 1985 is earlier than 1964, the significance of these relationships – particularly as they relate to river discharge – is unclear. Discharge in the nid to lower river in May of 1983, when the bulk of the fall chinook outmigration occurs, was substantially greater than in 1984 and 1985. In Nay of 1984, however, discharge was substantially greater than in May of 1985 yet the 1984 run clearly trails 1985. Relative run timing of fall chinook in these years may be impacted strongly by factors other than river discharge.

Migration rate of wild Nahces River spring chinook. In an effort to determine the capture efficiency of the Wapatox smolt trap on the Naches River, nine seperate releases of wild Naches River spring chinook were made between April 8 and May 7, 1985. As these fish were distinct ively freeze-branded, it was possible to estimate survival and migration rates to Prosser. These estimates are summarized in Table 21.

Table 21. Summary of survival and migration rate of branded Naches River spring chinook released above Wapatox smolt trap in 1985.

Release Date	Number released	Total estimated passage past Prosser	Estimated survival (percent)	Median capture date	Estimated migration rate (mi/day)
April 8	100	9	9.0	May 12	2.5
April 8	100	25	25.0	May 6	3.0
April 12	198	55	27.8	May 8	3.2
April 17	1%	19	9.7	May 10	3.6
April 20	149	20	13.4	May 16	3.2
April 23	20	4	25.0	May 13	4.1
April 25	99	18	18.2	May 19	3.4
April 29	151	41	27.2	May 21	3.8
May 7	117	10	8.5	May 24	4.8
mean			18.2		3.5

Two points are evident in Table 21: that the migration rate generally increases as the season progresses, and that the survival rate is quite low, ranging from 8.5 to 27.8 percent with a mean of 18.2 percent.

It was expected that the rate of migration would increase as the season progressed, as this sort of phenomenon has been noted elsewhere (Anonymous , 1983; Hart et al., 1981) and even within the Yakima Basin (see Appendix B) . The magnitude of tne observed migration rates are, however , relatively low, being comparable to those of hatchery spring chinook released directly into the upper Yakima River and Rattlesnake Creek (a tributary of the Naches River-see next section). Roth branded wild Naches River spring chinook and hatchery spring chinook hauled to the Yakima River and immediately released are physiologically stressed to some degree (Barton, et al., 1980; Barton and Peter, 1982; Strange and Schreck, 1978; Park and Narthews, 1982) and the low migration rates characteristic of these fish may reflect the disruptive effect of stress on smolt fitness and nigratory disposition (Schreck, 1982; Specker and Schreck, 1978) and the tine necessary for physiological recovery (Congleton et al., 1985; Redding and Schreck, 1983).

Somewhat more surprising are the low survival rates observed. To some degree, low survival rates are attributable to the stress of being captured and handled once and sometimes twice at Wapatox trap. The mean value of 18.2 percent is, however, comparable to the rates observed in 1985 for transported hatchery spring chinook smolts released immediately into Rattlesnake Creek and the upper Yakima, as well as to the rates observed for hatchery smolts allowed volitional migration from a holding pond on the upper Yakima (see next section). A low survival rate for such diverse and widely separated groups suggests that the cause may be some condition in the Yakima River belw the confluence of the Naches . For reasons previously discussed, it is proposed that this deleterious condition consisted of low flws.

6 .1.3.2 Hatchery Releases

Except for hatchery coho and steelhead, about 10 percent of all hatchery fish caught in 1985 were distinctively freeze-branded, and all were ad-clipped and coded wire tagged. Thus the outmigration of hatchery fish can be monitored in two ways; (1) by counting daily estimated outmigration of branded fish, or (2) by subdividing the estimated daily outnigration of all ad-clipped fish among test groups in proportion to the number of brands counted and the percent branding within each group. The latter approach may be useful if a certain percent of all branded fish are overlooked, assuming that this percentage is fairly constant among groups. For 1985 test groups only, survival was calculated both as the ratio of the seasonal passage of branded fish to the number of branded fish released, and as the ratio of the seasonal passage of all fish, branded and unbranded, from a given group to the total number released in that group. In all cases but one, survival was lower when estimated with brands alone.

Effect of acclimation and vol itionai release on survival. In 1985, the 45,195 hatchery spring chinook, 6,056 of which were branded, that were allowed to migrate on a volitional basis after 16 days of accl imat ion ("pond fisn") A total of 10,929 of these fish were estimated to nave migrated past Prosser in the spring of 1585. The estimated passage of branded fish from this group was 1,146. Survival was thus est imated at 18 .9 or 24.2 percent, depending upon whether the ratio was based on brands only or on all fish. Of the 42,210 hatchery chinook smolts released directly from a tank truck ("trucked fish") into the upper Yakima, 11 ,006 were estimated to have migrated past Prosser Dan. Similarly, 851 of 3,841 branded fish in the trucked group migrated past Prosser. Survival rates for the trucked group, based on brands and total fish were 22.2 and 26.1 percent, respectively. Table 22 summarizes the brand-based comparative survival of pond and trucked hatchery spring chinook from 1983 through 1985.

Table 22. Outmigration anti survival estimates for acclimated and non-acclimated hatchery spring chinook snolts in 1983-1985.

Year	Release group	Number of branded f ish released	Cst imated survival of branded fish	Percent survival
1983	Pond	9,905	3 ,881	39.2
	Trucked	8,225	1,760	21.4
1984	Pond	4,653	2,522	54.2
	Trucked	6,818	2,227	32 .7
1985	Pond	6,056	1,146	18.9
	Trucked	3,541	851	22.2

As is evident from Table 22, the relative survival-to-Prosser of pond versus cruckcd hatchery spring chinook snolts has changed dramatically in 1985. The survival ratio of pond to trucked smolts in 1983 and 1984 was 1.8 and 1.6 respectively, while the ratio for 1985 was 0.85. Furthermore, while the absolute survival rates for trucked smolts has remained fairly constant, the absolute rate for pond smolts in 1985 has declined.

There are a number of possible reasons for the low survival of pond smolts in 1985. One factor is the previously rnectioncd fact that spring river discharge generally decreased from 1983 to 1985. Discharge at Prosser Dar; in April and May of 1983 was substantially greater than the comparable figures for 1985. The difference between spring river discharge patterns for 1985 and 1983 is reflected in Figures 25 and 26, which show the outmigration of both pond and trucked smolts being later, and therefore subject to a longer period of predation in 1985 than in 1983 (this in spite of the fact the respective median release dates of 1983 pond and trucked smolts was 8 and 9 days later than in 1985). The comparison between 1984 and 1985 is complicated by the fact that discharge at and above Prosser Dam was relatively less in April of 1984 than in April of 1985, and greater in May of 1984 than May of 1985. Any difference in the hydraulic impact on outmigration timing in 1954 and 1985 may have "cancelled itself out" in April and May In any case, there is no difference between 1984-1955 in timing, for either trucked or pond smolts.

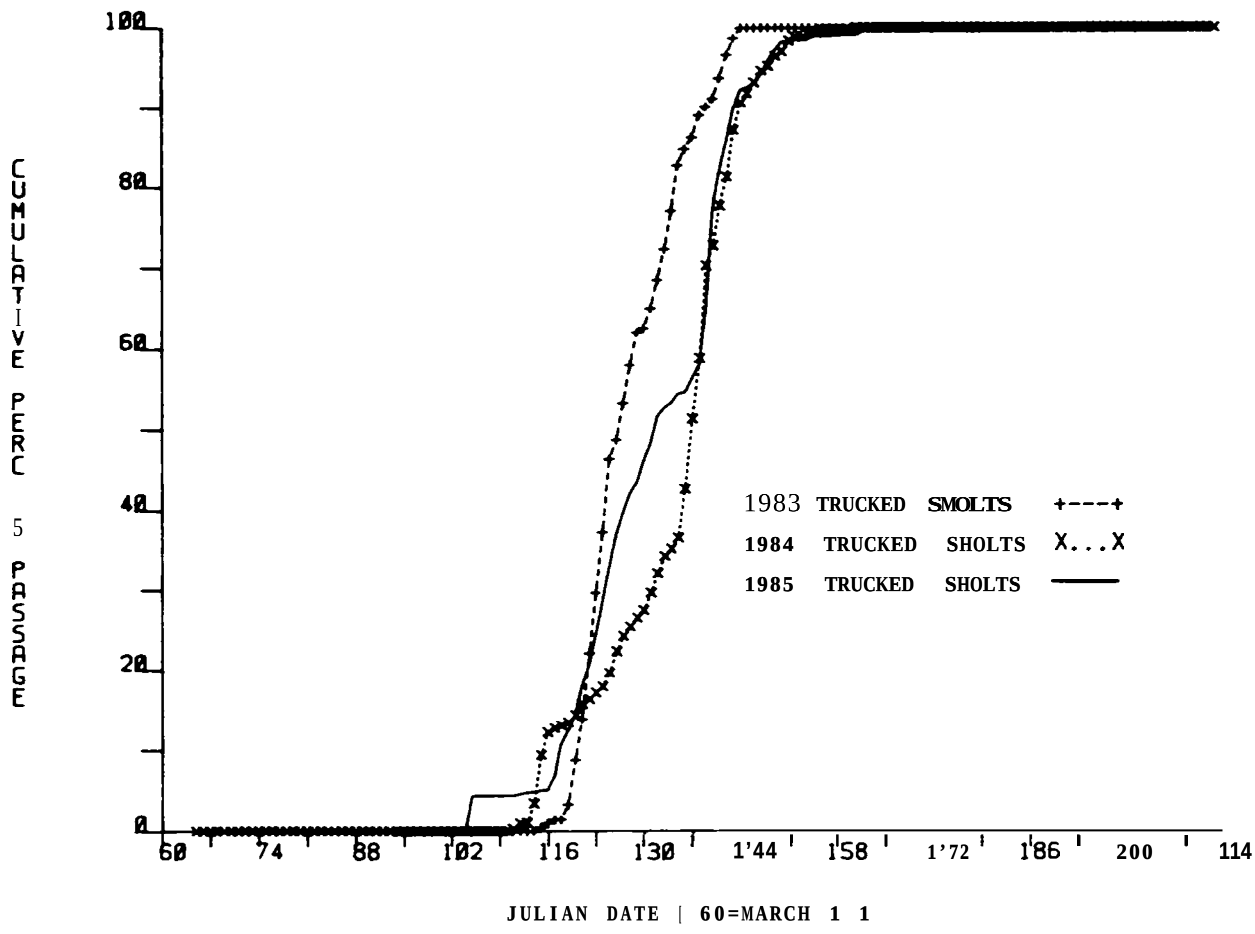


Figure 25. Cumulative percent passage of trucked (non-acclimated) hatchery spring chinook smolts past Prosser Dam in 1983, 1984, and 1985.

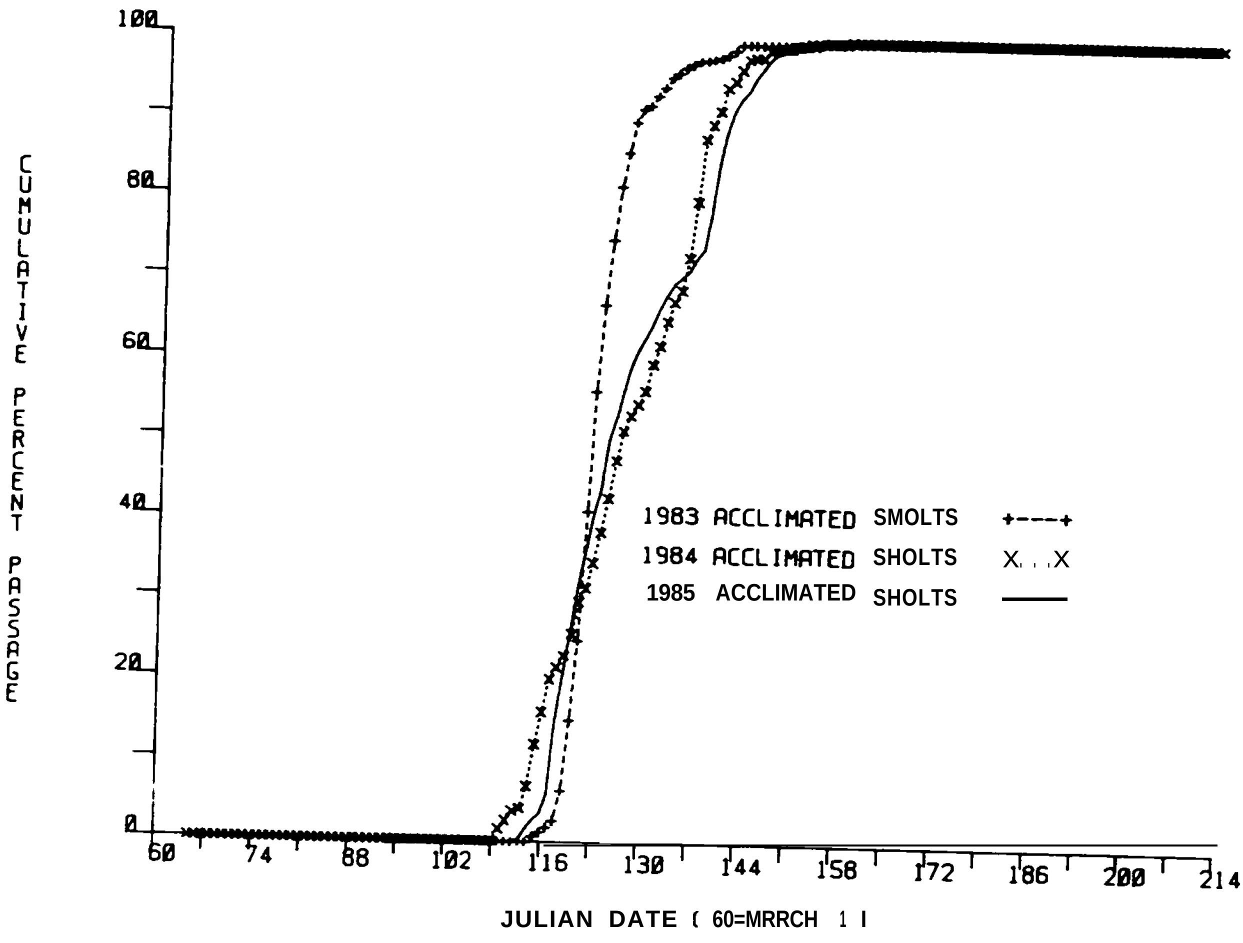


Figure 26. Cumulative percent passage of acclimated (pond) hatchery spring chinook smolts past Prosser Dam in 1983, 1984, and 1985.

If the comparatively lower discharge in May of 1985 versus May of 1984 contributed to the fact that survival of pond s,p;ts in 1985 was about one third of the 1984 value, the mechanism may have been the reduction of deep-water refuges, and the concentration of predator ant prey.

Another complication to the understanding of depressed survival of pond snolts in 1985 is the location of the acclimation pond and the acclimation time the fish were allowed.

Nile pond was used as the acclimation pond in 1983 and 1984, whereas Mary's Pond was used in 1985. iiile pond is just off the Naches River, at RM 29, 98 miles above Prosser Dam, whereas Mary's Pond is just off the Yakima River, at RM 192, 144.9 miles upstream of Prosser Dam. Smolts leaving Nile Pond first negotiate 29 miles of rapid water in the lower Nahces, and must traverse only 69 miles of the slower Yakima River before reaching Prosser. On the other hand, fish leavin, Mary's Pond must traverse 145 miles of the Yakima including the pool above Roza Dam. Simply by virtue of having to "run a longer gaunt 1 et, " one would expect a somewhat lower survival rate fcr smolts leaving Mary's Pond. More important ly, signif icant ent rainment 2nd impingement problems are associated with the rotary screens at the Roza Canal inlet. A number of studies (Anonymous, 1967) employing Fyke nets fished in the canal have demonstrated that large numbers of chinook and steelhead snolts are able to swim through the present screening structures. More recently, Yakima Nation biologists nonitored impingement mortalities 2 hours a day (0530 hrs to 0630 hrs ant 2120 hrs to 2230 nrs) from June 18 through August 14, 1984. Al so in 1984, the salmonids that were stranded in Roza Canal when it was dewatered in late October *wree* enumerated by electrofishing. A total of 1,745 dead hatchery chinook (primarily June-released fry - see following section) and 113 dead wild chinook were removed from the screens, and over 400 juvenile chinook were electrofished from pools of standing wat er in the canal after dewatering. Losses of outmigrant s associated with the Roza Canal diversion are obviously large anti undoubtedly contributed to the reduced survival of pond smolts in 1985 The outmigrant diversion screening facilities at Roza Canal *are* now being retuilt with an expected completion date in March, 1987).

The *decree* of acclimation for 1985 smolts also differs from previous years. Hatchery spring chinook were transferred to Nole pond on January 24 and 27, 1983, for the 1983 release; and on October 25 and Nov ember 1, 1983, for the 1934 release. Residence tine for 1983 and 1984 pond smolts was thus about 2 and 5 months, respectively, and during this time the fish fed on both natural and aritifical food. In 1935, now ever, impassable snow drifts made it impossible to begin to move fish until Aprii first. As the transfer was complete April third, the mean residence time for 1985 pond smolts was only ten days. To the extent that increased familiarity with a natural environment and natural foois improves smolt fitness, one would expect that pond smolLt in 1983 and 1984 **would** fare better than their counterparts in

1985.

Mean size at release apparently played no role in the relative survival of trucked and pond smolts over the past three years. As Table 23 demonstrates, the mean size at release for pond smolts was comparable over all three years. Moreover, the 1954 trucked group had a higher survival rate than any other trucked group in spite of the fact they were smallest when released.

Table 23. Mean lengths of hatchery spring chinook before being released into acclimation ponds or the Yakima River in 1983-1985, and as captured at Prosser smolt trap in April, May and June.

		Mean Fork Length				
Year	Release group	At Release (mm)	April Recaptures (mm)	May Recaptures (mm)	June Recaptures (mm)	Seasonal Survival Rate (percent)
1983	Acclimated Nile Pond	123	142 (n=5)	130 (n=8)	no data	39.2
1983	trucked	146	168 (n=1)	i29 (n=11)	112 (n-1)	21.4
1984	Nile Pond	128	no data	145 (n=49)	154 (n=1)	54.2
1984	trucked	114	no data	139 (n=63)	149 (n=1)	32.7
1985	Mary's Pond	127	149 (n=111)	148 (n=142)	146 (n=5)	18.9
1985	trucked	126	154 (n=37)	147 (n=115)	16 (n=3)	22.2

An interesting phenomenon is evident from a comparison of the mean lengths of April and Nay recaptures of hatchery smolts versus the mean release length in 1983 and 1985. In both years and for both groups, the mean length of April recaptures is about 20 mm longer than the mean length at release. Seining data from 1985 indicate that the April growth rate of wild Yakima spring chinook is approximately 10mm per month. If April recaptures had not been subject to some form of size selection, the mean length of April recaptures should not have been more than about 5mm greater than release length, assuming hatchery smolts grow as fast as wild chinook. In 1983, however, the mean length of May recaptures dropped substantially, while May, 1985 lengths remain essentially unchanged. These site trends are consistent with the hypothesis of discharge-mediated smolt survival. Regard1 ess of discharge, larger smolts migrate faster, simply because they are faster swimmers. Thus, wild spring chinook smolts captured in March, and the first hatchery spring chinook to be captured after their April release, are larger than at any other time. Discharge, however, influences the mean size of smolts caught after the initial wave. During high flows, small smolts are carried downstream more rapidly, suffering fewer predatory mortalities, inflating the overall survival rate, and "def1ating': average s ite.

The data from 1964 are not consistant with this hypothesis. Flows in 1984 were nearly as low as in 1985, yet survival to Prosser for both trucbcd and pond smolts was greater than any other year.

Conceivably, 1984 pond fish, by virtue of their extended residence in a natural environment were capable of finding and utilizing cover as well as wild fish, and much better than hatchery fish. Such reasoning, however, does not account for **the** superior survival of 1984 trucked smolts. Resolution of this issue requires additional **data** particularly regarding the relationship between river discharge and mortality, and discharge and entrainment, at the Roza Canal diversion screens.

Outmigration rates of pond and trucked hatchery spring chinook. Figures 27, 28, and 29 show the comparative timing of outmigrat ion of pond and trucked smolts in 1983, 1984 and 1985. In all **years** the outmigration of trucked smolts lags behind pond smolts. Dates of median passage for trucked smol ts were 3, 10 and 6 days later than the median passage date of pond smolts in 1983, 1984 and 1985 respectively. Dates of 50 and 75 percent passage are summarized in Table 24.

Table 24. Dates of 50 and 75 percent outmigration to Prosser for accl inated and non-acclimated hatchery spring chinook **in** 1983, 1984 and 1985.

Year	Release group	Median Release Date	Date of 50 % Passage	Date of 75 % Passage
1983	Acclimated	April 20	Nay 3	May 5
1983	non-acclimated	April 20	May 6	May 14
1984	Accl inated	April 15	May 6	May 15
1984	non-acclimated	April 13	May 6	May 19
1985	Accl inated	April 12	May 5	May 18
1985	non-acclimated	April 11	May 11	May 20

Migration speed in miles per day reflects the relationships in Figures 27-29.

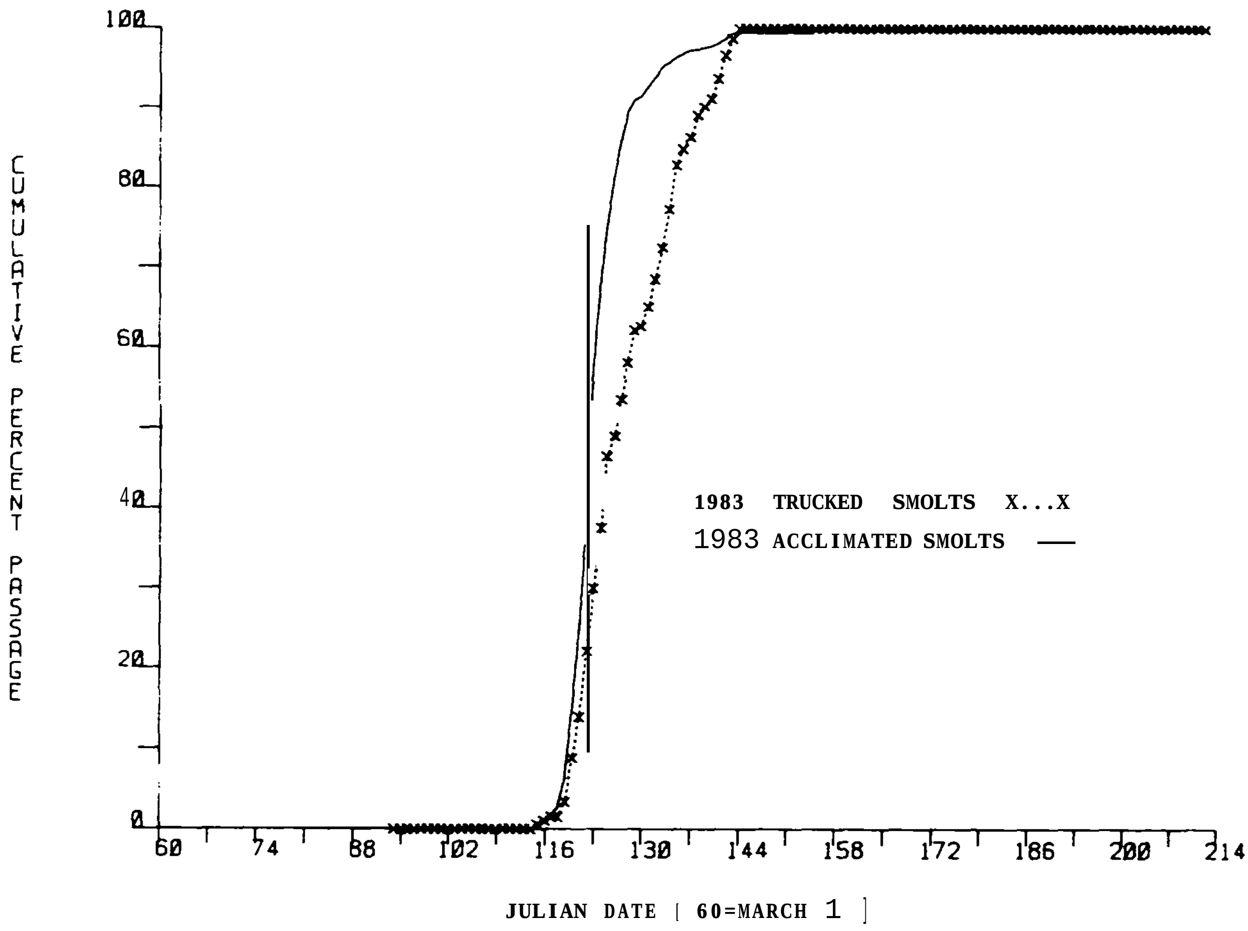


Figure 27. Cumulative percent passage of trucked (non-acclimated) and acclimated (pond) hatchery spring chinook smolts past Prosser Dam in 1983.

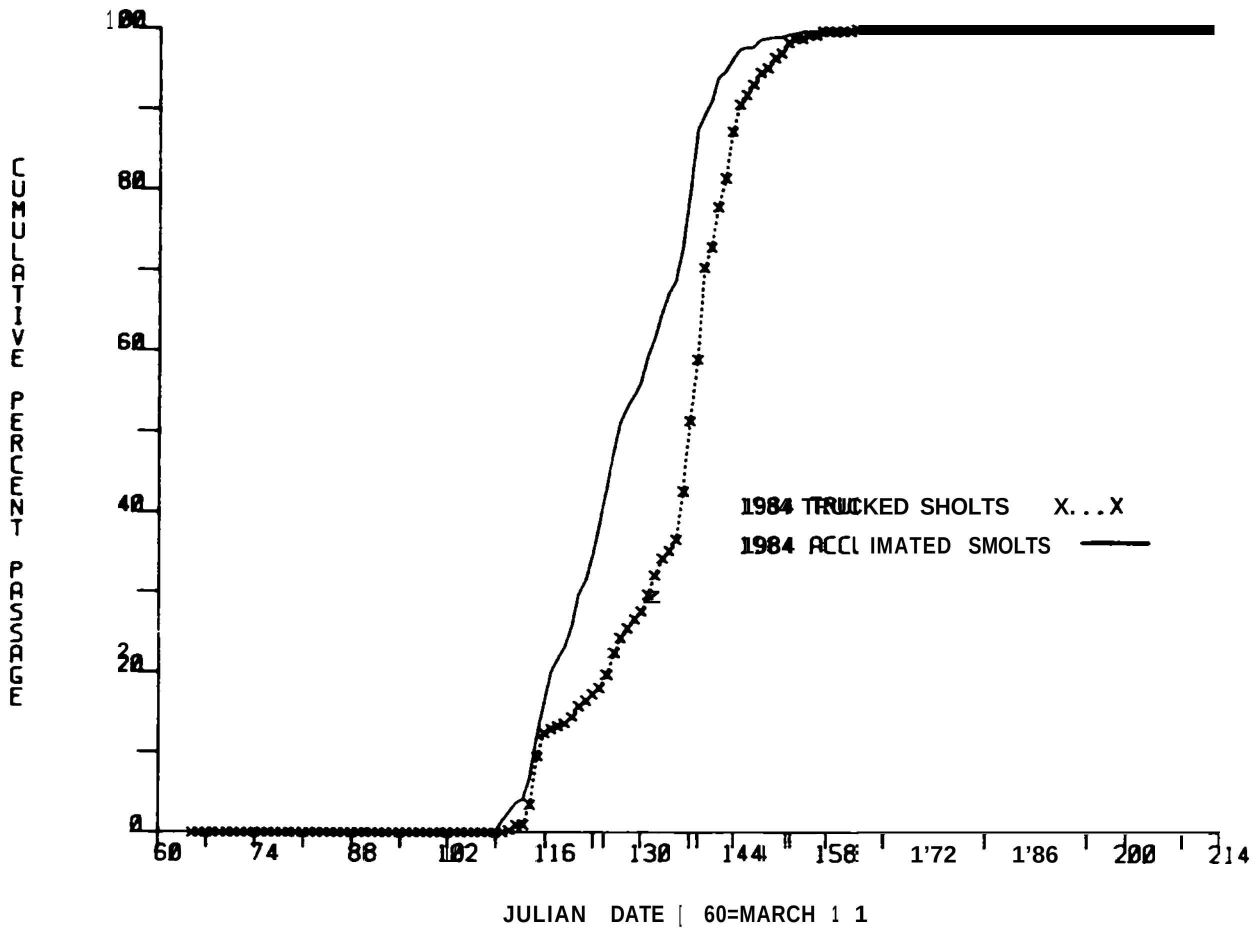


Figure 28. Cumulative percent passage of trucked (non-acclimated) and acclimated (pond) hatchery spring chinook smolts past Prosser Dam in 1984.

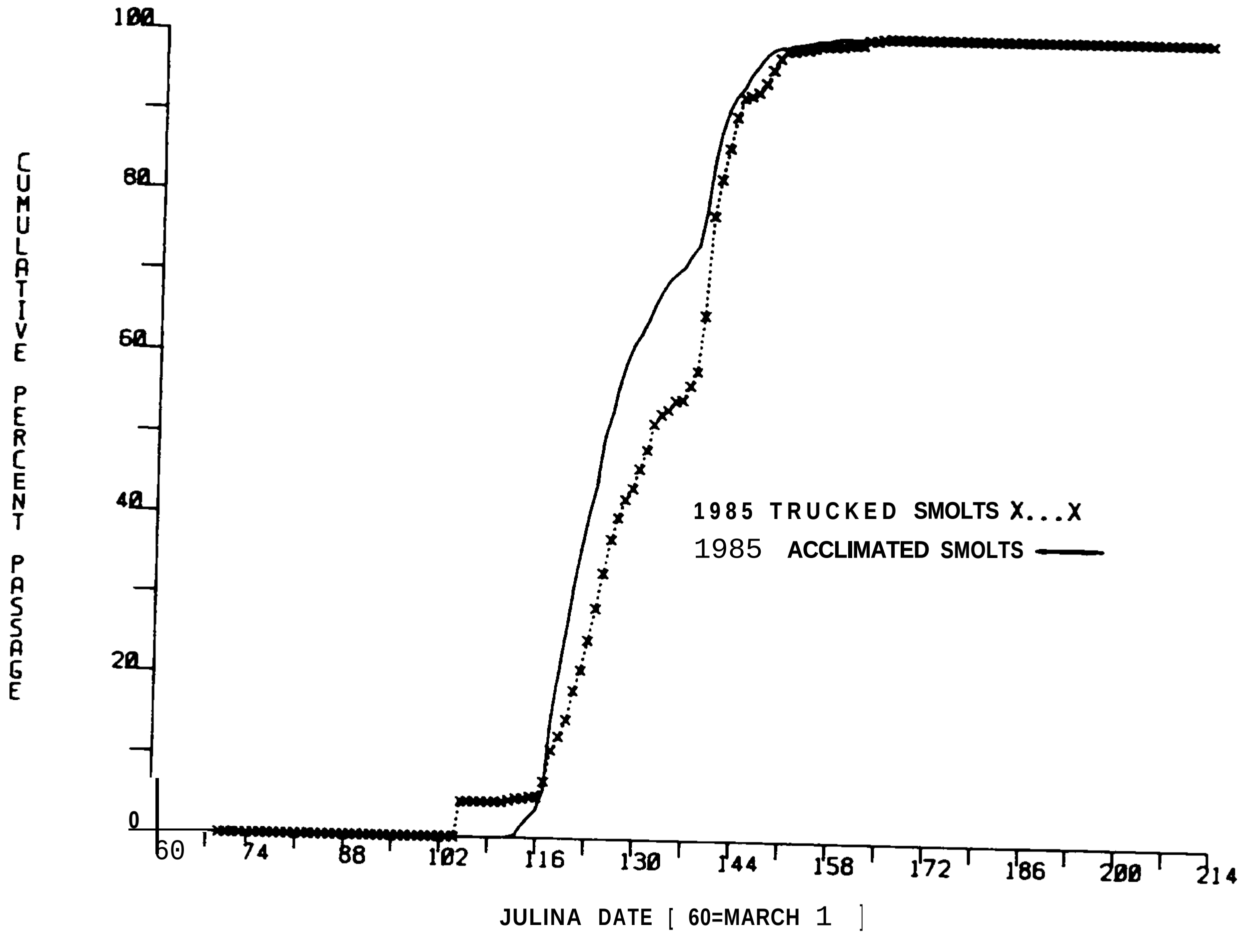


Figure 29. Cumulative percent passage of trucked (non-acclimated) and acclimated (pond) hatchery spring chinook smolts past Prosser Dam in 1985.

Pond smolts began their migration at Nile pond on the iiaches in 1933 and 1984, and at Mary's Pond on the Yakima in 1985. These points are 98 and 145 miles above Prosser Dam, respectively. Median travel time for pond smolts in 1983, 1424 and 1985 was 13, 22 and 23 cays. Therefore the median speed of migration for pond smolts was 7.5 mi/day in 1983, 4.4 mi/day in 1984 and 6.3 **mi/day** in 1985. The median release point for trucked smolts in all three years was RM 165.1 oi the Yakima River, 118 miles above Prosser Dam. Median travel tines for trucked smolts in 1983 through 1985 ***were*** 16, 37, and 30 days, respectively and the speed of migration in **these** years was 7.4, 3.2, and 3.9 miles per day (Table 25).

Table 25. Speed of uigration for Leavenworth N.F.H. spring chinook smolts released from acclimation ponds or palnted.

Migration Speed in Miles/Day

Year	Acclimation Pond	River Release
1983	7.5	7.4
1984	4.4	3.2
1985	6.3	3.9

These figures bear no obvious relationship either to spring discharge or to estimated survival.

Figure 30 shows the relative outmigration timing of wild spring chinook smolts, and trucked and pond hatchery spring chinook smolts in 1985.

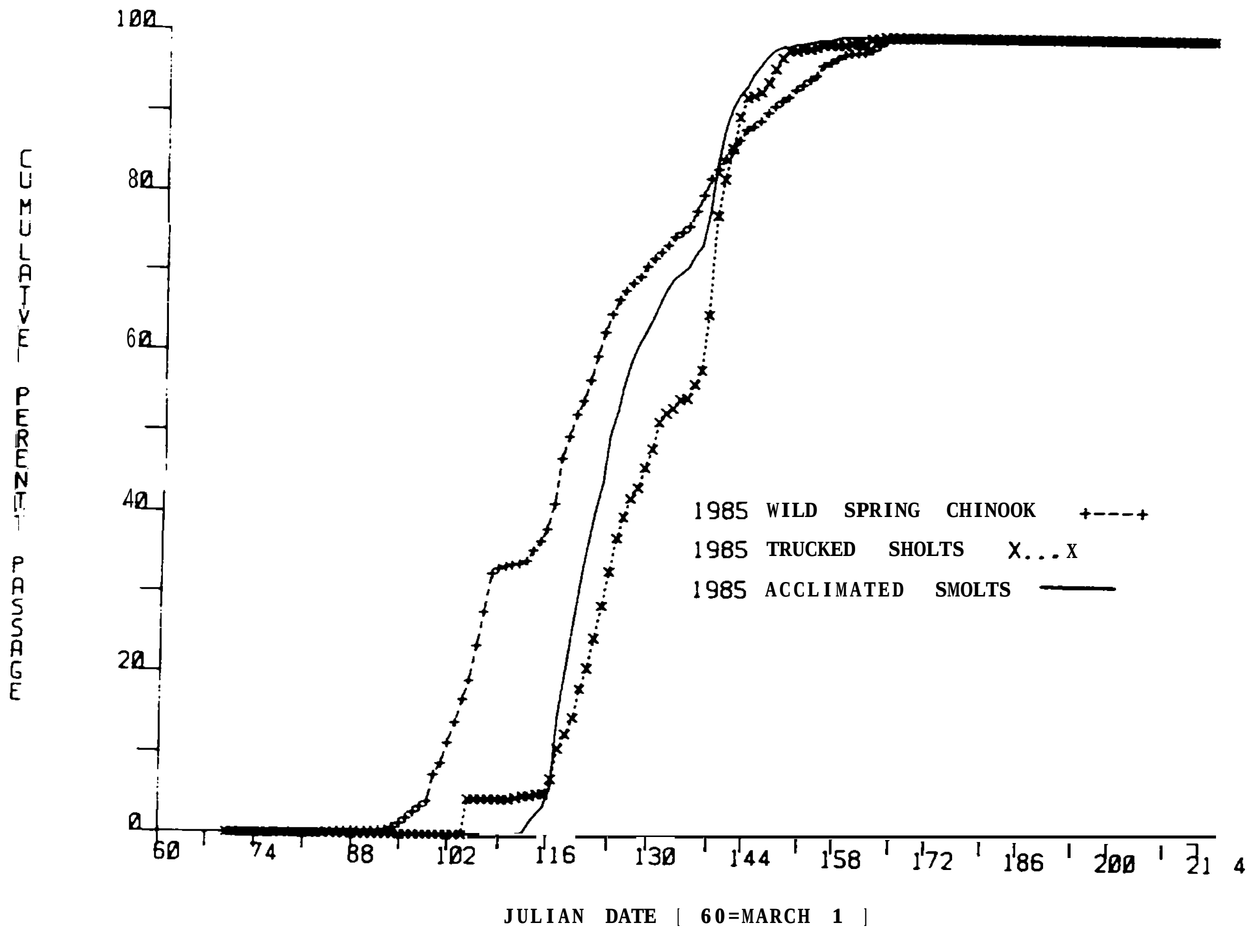


Figure 30. Cumulative percent passage past Prosser Dam of wild spring chinook smolts, pond (acclimated) hatchery spring chinook smolts, and trucked (non-acclimated) hatchery spring chinook smolts in 1985.

As in previous years, both hatchery groups initially trail wild fish because of their late release dates,

Effect of fall release of hatchery spring chinook parr on survival to snolt. The total number of Leavenworth N.F.H. spring chinook pre-smolts scatter-planted in the Yakima River in September and November 1984 was 102,333 and 108,305, respectively. Of these numbers, 10,489 of the September fish and 10,526 of the November fish were branded. During the smolt run of 1985, it was estimated that 963 branded fish and 3,423 unbranded fish from the September release migrated past Prosser Dam. Comparable figures for the November release were 318 and 3.418. Thus, based solely on recaptures of branded fish, the total survival to smolt at Prosscr was 9.2 percent for the September release and 3.0 percent for the November release. Survival rates for September and November releases based on total estimated outmigratoin were 9 .1 and 3.4 percent, respectively.

The survival figures for September and November released pre-smolts must be qualified somewhat by the fact that nine September released pre-smolts and 19 November released pre-smolts were caught in the fyke net fished in Chandler Canal in late January and early February. Allowing for the efficiency of the net and the estimated canal entrainment rates on the dates of capture, these figures imply that approximately 89 September released pre-smolts and 151 November released pre-smolts migrated past Prosser Dam in late January and early February. The possibility exists that much larger numbers of September and November released hatchery chinook had already migrated past Prosser Dam before the fyke net was installed.

Mean monthly lengths of recaptured September and November hatchery chinook are listed in Table 26.

Table 26. I-lean monthly lengths of recaptured hatchery spring chinook released as parr in September and iiovember in 1984. Listing is by month of capture in 1985.

Rel case group	at release (mm)	January 1985 (mm)	February 1985 (mm)	March 1985 (mm)	April 1985 (mm)	May 1985 (mm)	June 1985 (mm)
	Mean fork 1ength						
September	115	182	126	182	147	145	151
November	117	144	185	no data	153	148	151

As growth between September or November and April was probably negligible, the length data in Table 26 seem to indicate that only the larger fish of each release survive migration to Prosser.

Figures 31 and 32 depict the comparative run timing of November and September released hatchery chinook parr and wild spring chinook in the spring of LS85. As was the case for other test releases of hatchery chinook, the group with the higher survival rate to Prosser, the September released chinook, migrated faster than the group with the Lower survival rate.

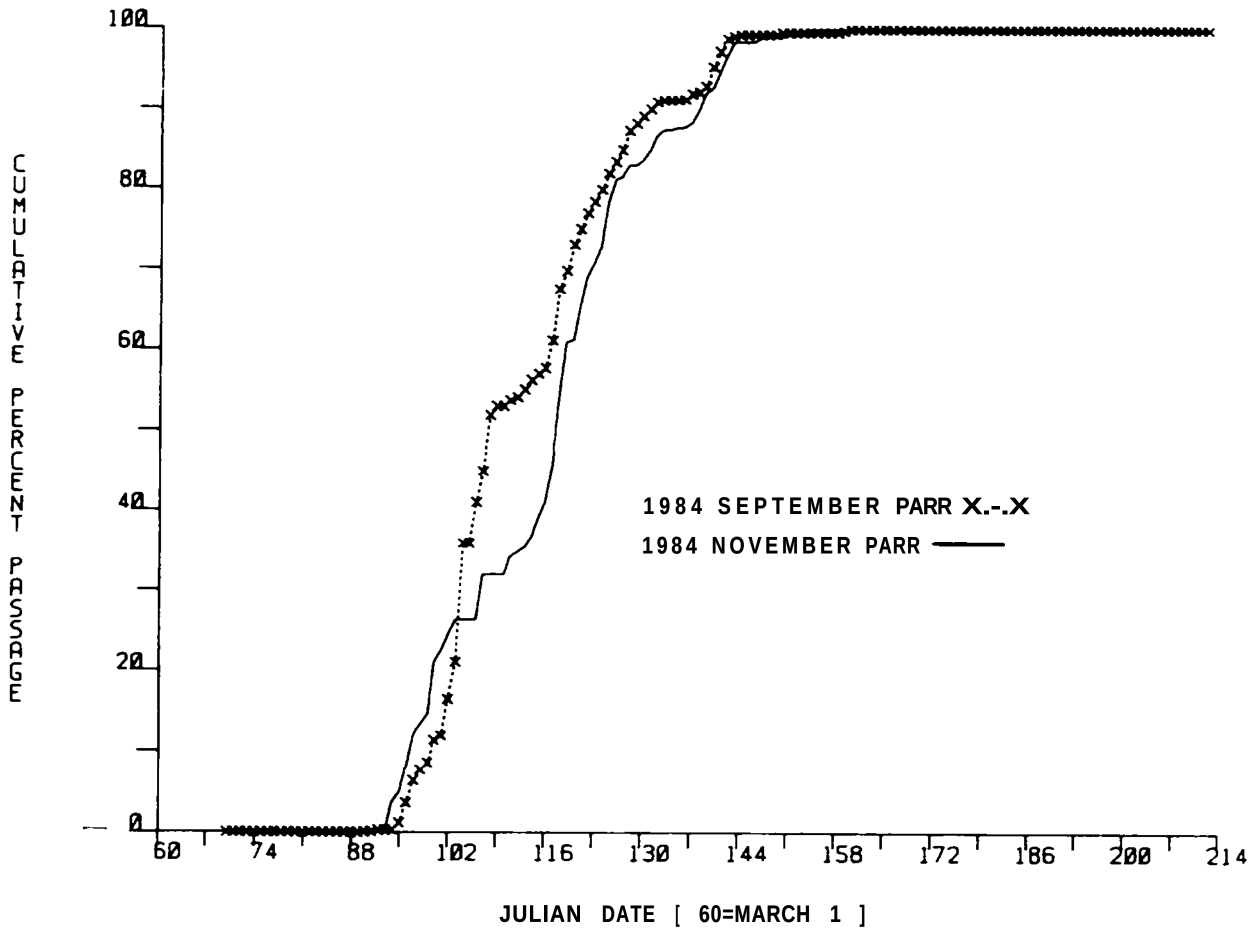


Figure 31. Cumulative percent passage past Prosser Dam in 1985 of hatchery spring chinook smolts released as parr in September and November of 1984.

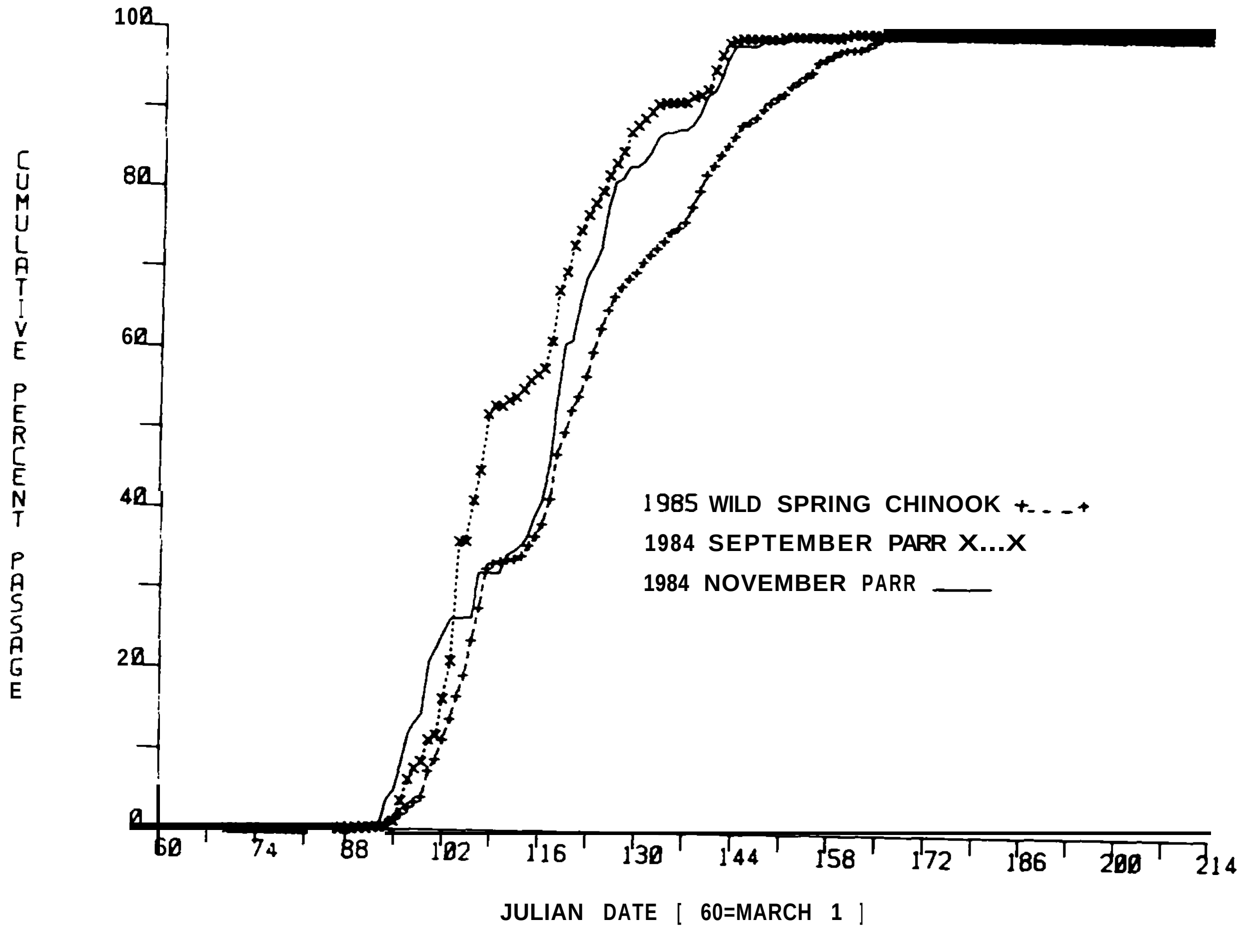


Figure 32. Cumulative percent passage past Prosser Dam in 1985 of wild spring chinook and hatchery spring chinook released as parr in September and November of 1984.

The relative run timing of these test releases differs, however, from all previous truck-pond releases in that they precede the wild spring chinook run (Table 27).

Table 27. Dates of 50 and 75 percent passage for wild spring chinook smolts, and for hatchery spring chinook released as pre-smolts in September and November, 1964.

Study group	Date of Passage	
	50%	752
Wild Spring Chinook	April 29, 1985	May 14, 1985
September release	April 18, 1985	May 1, 1985
November release	April 28, 1985	May 4, 1955

Passage of one group might precede another if both began migration at the same point but the earlier group simply swam faster. Alternatively, such a situation could arise if the earlier group began migration further down-river. A decision between alternatives cannot be made on the basis of current Gata.

Survival to smolt of June release of hatchey spring chinook fry. A total of 101,191 Leavenworth N.F.H. spring chinook fry, 9,102 oi which were branded, were scatter-planted in the upper Yakima on June 11 , 1985. A similar release of 102,837 chinook fry, 8,124 of which were branded, occurred on June 5 and 6, 1984. In 1985. June and July recaptures of the 1955 release totalled 247 branded and an estimated 3,7 85 unbranded f ish. Thus, expressed as the ratio of total passage of branded fish to branded fish released, 2.7 percent of the fry released in June, 1985 migrated past Prosser the summer they were released. Expressed in terms of all fish, branded and unbranded, the “premature” outmigration rate was 4.0 percent. No fish from the 1984 release were captured in the spring of 1985. It was therefore assumed that all fish in this group had either migrated in the summer of 1984 or in the (Largely unmonitored) fall and winter of 1984-1985. or had died. One branded fish from the June, 1984 fry release was caught in the winter of 1984-1985, and 1,183, or 13.3 percent, were caught in June and July of 1984. Thus, none of the 1984 fry achieved the status of "smolt-at-Prosser." Whatever returns may result from this release will probably have to come from the 13.3 percent that migrated as pre-smolts.

The outmigration of 1984 pre-smolt hatchery chinook may well have been considerably greater than indicated. A very large number of spring chinook fry and hatchery fall chinook smolts suddenly appeared in the smolt trap the night of July 4, 1984, overwhelming the staff on Hand. To avoid mass mortality, the trap was by-passed, and an undetermined number of fish were returned, uncounted, to the river.

In light of the uemonstrated relationship between discharge and outmigratoin it is very probable that the reason nearly five times as many June-released chinook fry migrated prematurely in 1984 as in 1985 was that the discharge in late June and early July of 1984 was four to five times as great as in 1985 (Figure 6). A glance at Table 28 establishes that the difference was not due to a combination of different mean release sizes and size-selective mortalities.

Table 28. Mean fork lengths of Leavenworth N.F.H. spring chinook fry at release in June of 1984 and 1985, and as recaptured at Prosser smolt trap in June and July.

	Piean fork lentgh		
Release Group	Release (mm)	June recapture (mm)	July recapture (mm)
June, 1884	83	101	112
June, 1985	83	105	114

As is evident in Figure 33, the timing of the pre-smolt “runs” in 1984 and 1985 was rapid and similar in spite of radically different flows and a 4-5 day difference in release dates (Table 29). As the number of days to 50 percent passage in 1984 and 1985 were 2C.5 and 27, respectively, the speed with which the June fry traveled the 118 miles between their median release point and Prosser Dam was 4.1 miles/day in 1984 and 4.4 miles/day in 1985.

Table 29. Dates of release and 50 and 75 percent passage of spring chinook fry released in June of 1984 and 1985.

	Date of Passage		
Year	Release	50%	75%
1984	June 6-7	July 4	July 7
1985	June 11	July 8	July 14

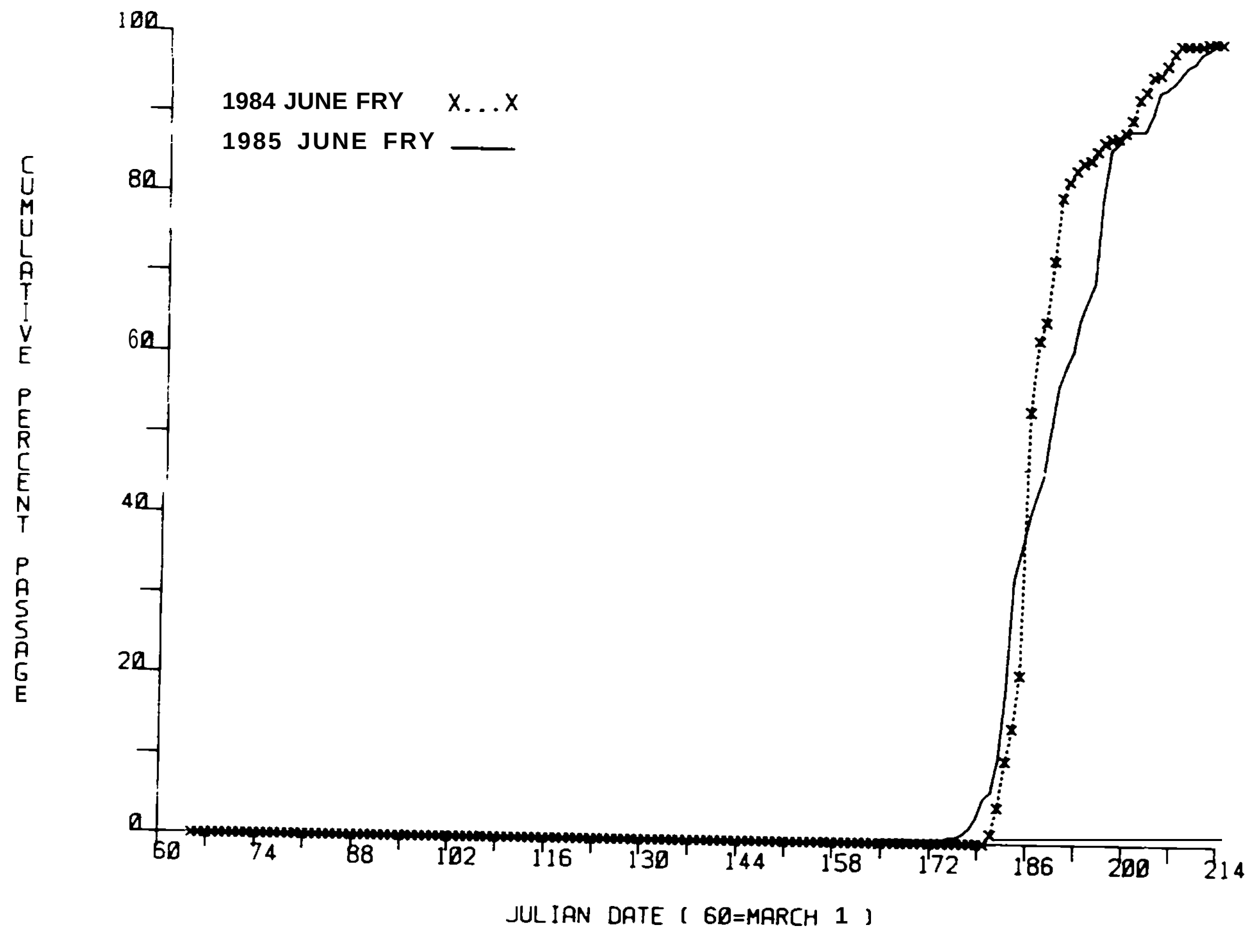


Figure 33. Cumulative percent passage past Prosser Dam in 1984 of hatchery spring chinook released as fry in June 1984 and cumulative percent passage past Prosser Dam in 1985 of hatchery spring chinook released as fry in June 1985.

Hatchery steelhead. The Yakiea chapter of the Northwest Steelheader's Club of America released 88,484 ad-clipped hatchery steelhead at two sites on the Naches River (Wapatox and Nelson Springs) on April 8, 1955. An estimated 33,776 of these fish subsequently migrated past Prosser Dam, indicating a survival rate of 38.2 percent. Survival rates for hatchery steelhead snolts released in 1984 and 1983 were 23.6 and 18.3 percent, respectively (Table 30).

Table 30. Summary of hatchery steelhead released in the Yakina River in 1983, 1984 and 1985.

Year	Release date	Number released	Number recaptured	Survival to Prosser (percent)
1983	April 8	64,810	11,362	1s.3
1984	April 17	49,238	11,648	23.6
1985	April 8	88,484	33,776	3S.2

Reasons for the steady improvement in survival over years of progressively worsening flows are not apparent. It was, however, the subjective impression of Prosser smolt trap personnel that the physical condition, as reflected by the decreased incidence of "pinheads", fish with mutilated caudal and pectoral fins, and other maladies, has improved over the past three years.

Figure 34 shows the relative timing of the wild and hatchery steelhead smolt runs in 1985. Figure 35 compares the timing of the hatchery steelhead outmigration in 1983, 1984 and 1985.

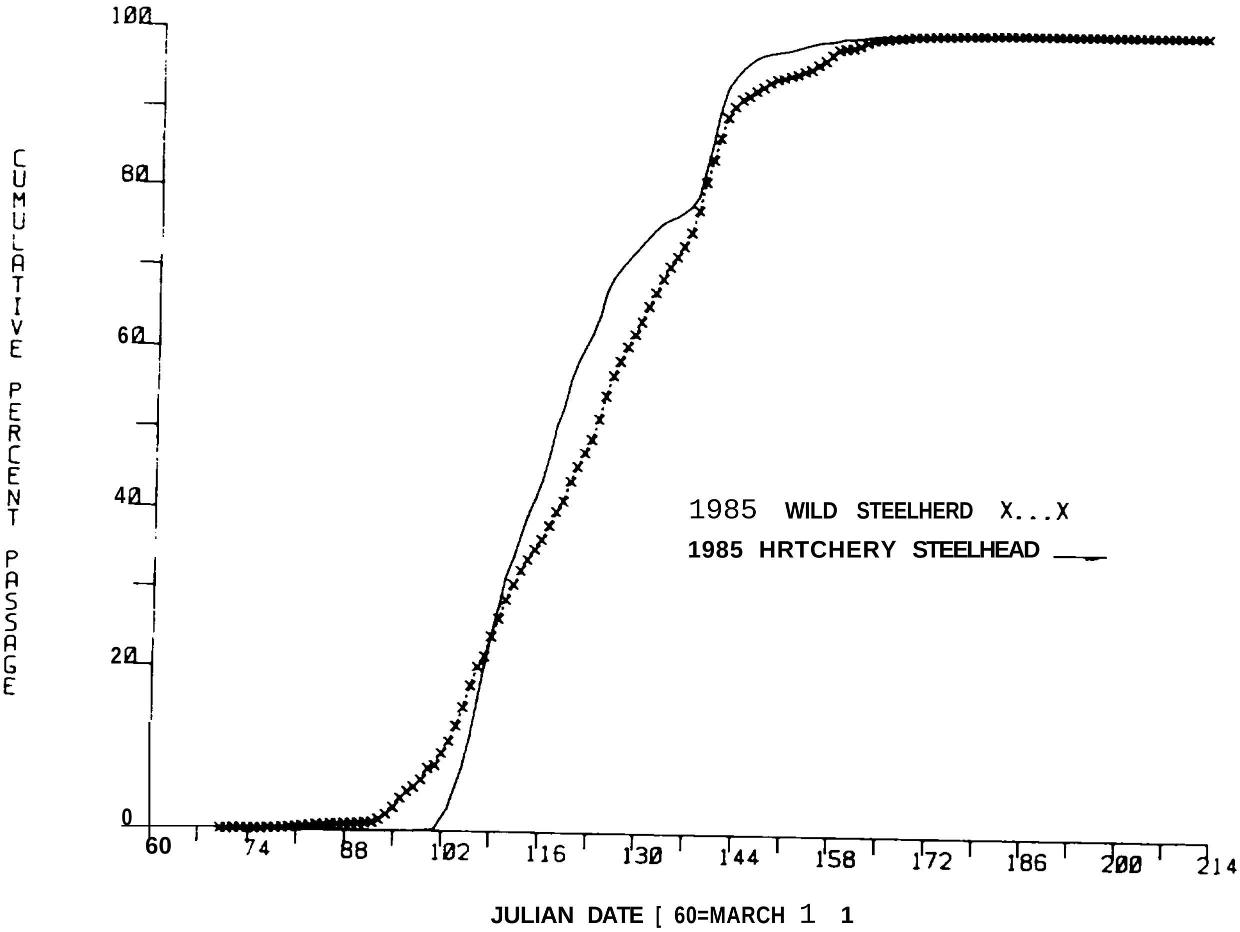


Figure 34. Cumulative percent passage past Prosser Dam of wild and hatchery steelhead smolts in 1985.

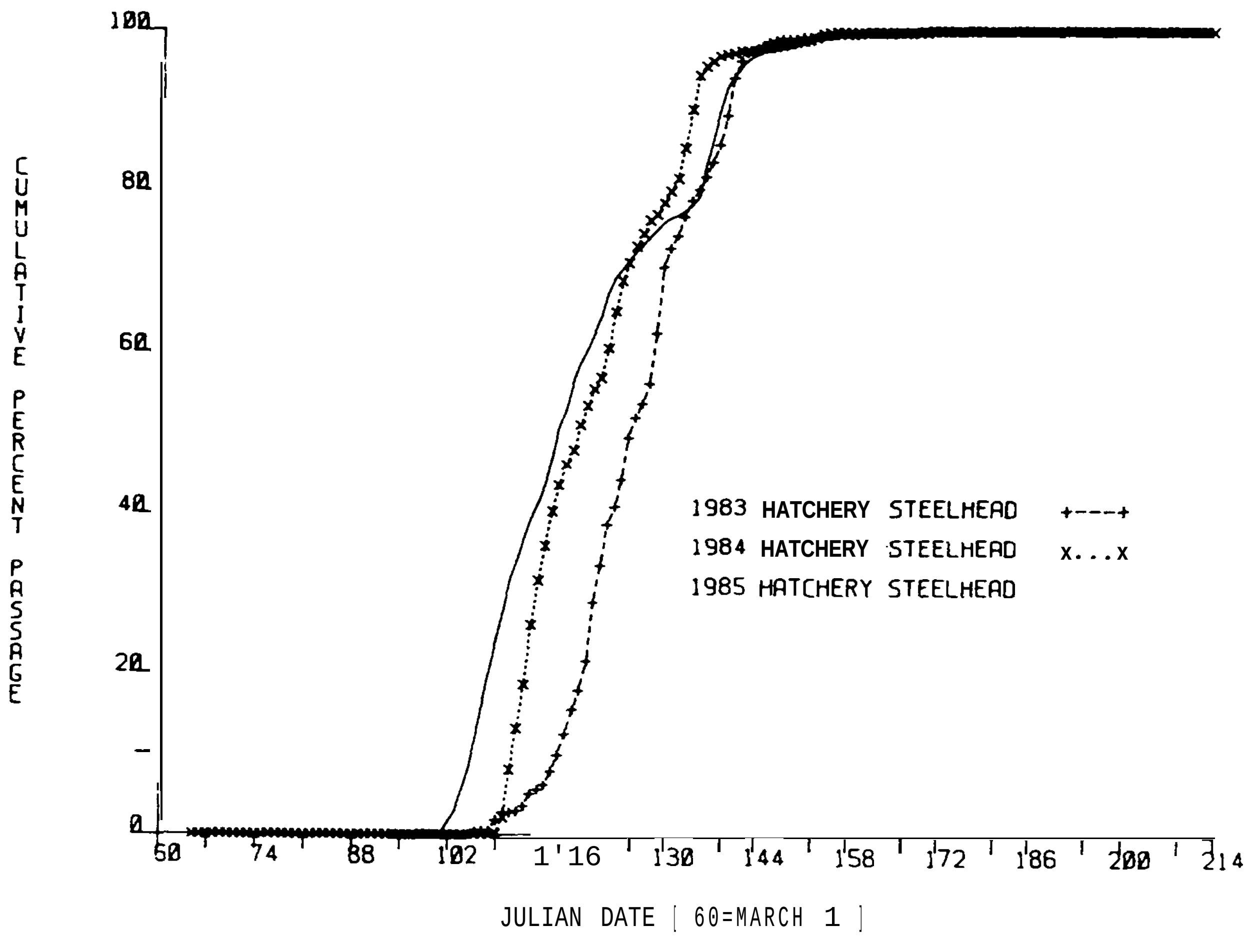


Figure 35. Cumulative percent passage past Prosser Dam of hatchery steelhead smolts in 1983, 1984, and 1985.

As has been observed for hatchery and wild chinook, the outmigration of hatchery steelbead is more compressed in time than that for wild steelhead (Table 31). This probably reflects the artificial delay in the beginning of the hatchery outmigration, and a gradual increase in speed of migration as the season progresses. The most significant aspect of the comparison of hatchery runs from 1983 through 1985 is the initial delay for the 1983 group. The extra time the 1983 smolts spent in the river probably contributed to their low survival rate.

Table 31. Dates of 50 and 75 percent passage for wild and hatchery steelhead in 1985.

Study group	Date of Passage 50%	75%
Wild steelhead	May 3	May 17
Hatchery steelhead	April 28	Hay 12

As one third of the hatchery steelhead in 1985 were released at Kapatox trap (56.3 miles from Prosser Dam) and two thirds were released at Nelson Springs (72.5 miles from the trap) the median release point was 79.4 miles from the trap. With a median travel time of 20 days, the 1985 hatchery steelhead migrated roughly 4.0 miles per day. Hatchery steelhead were released exclusively from Nelson Springs in 1983 and 1984, and median travel time to Prosser Dam was 30 and 13 days, respectively. The median migration speed of hatchery steelhead in 1983 was therefore 2.0 miles per day, compared to a rate of 5.6 miles per day in 1984.

It is not surprising that the migration speed of 1984 steelhead smolts should be greater than the rates in 1985 and 1983. Steelhead smolts were released on April 3 in 1983 and 1985, and April 17 in 1984. The 1984 steelhead probably became more fully smolted during their additional nine days of confinement, acquiring a more urgent migratory disposition. It is, **however,** quite surprising **that** tile 1983 group should have migrated so much more slowly than the 1985 group; release dates were identical and river flow was much greater in 1983. Several studies have shown that a number of indices of smoltification are depressed by stress (Schreck, 1982; Park and Matthews, 1932; Sepcker and Schreck, 1978). One can only speculate that rearing conditions were more stressful for the 1953 group, which may have suffered a stress-induced suppression of snoltification persisting several weeks after release.

Hatchery fall chinook smolt releases. On June 13, 1985 a total of 99,655 hatchery fall chinook, 11,450 of which were branded, were released between **the** confluence of the Yakima and Naches Rivers and Sunnyside Dam. A total of 1,813 branded and 20,331 unbranded hatchery fall chinook subsequently migrated past Prosser Dam. A similar release of 103,722 fall chinook was made on June 15, 1984. None of these fish were branded, but all were ad-clipped. Outmigration of hatchery fall chinook in 1984 totalled 32,246. Survival to Porsser in 1985 was 15.8 and 22.2 percent, based on brands alone, or on all fish respectively. Estimated survival of 1984 hatchery fall chinook was 31.1 percent. As was suggested in the explanation of the fact the outmigration of hatchcry spring chinook fry in 1984 **exceeded** 1985, it is probable that greater river discharge in late June and **early** July of 1984 aided the outmigratoin of hatchery fall chinook in 1984.

Figure 36 depicts outmigration of hatchery fall chinook in 1984 and 1985.. Timing is quite similar, and reflects the fact that the 1984 release occurred three days later in June than the 1985 release (Table 32).

Table 32. Dates of release, and passage of 50 and 75 percent of hatchery fall chinook past Prosser Dam in 1984 and 1985.

Year	Date	Date of Passage 50%	Date of Passage 75%
1984	June 15	July 5	July 3
1985	June 13	July 1	July 4

Hatchery Coho. From Hay 20 through May 31, a total of 260,690 hatchery coho smolts were scatter planted between the confluence of the Naches **and** Yakima Rivers and Wapato Dam. None of **these** fish were branded or **coded wire tagged.** It was estimated that 90,643 of these fish migrated past Prosser, resulting in a survival rate of 34.8 percent.

Figure 37 shows that the outmigration timing of these fish was sharply compressed. Dates of 50 and 75 percent passage were June 5 and June 7, respectively , and passage was better than 90 percent complete on June 10, 12 days from the capture of the first fish.

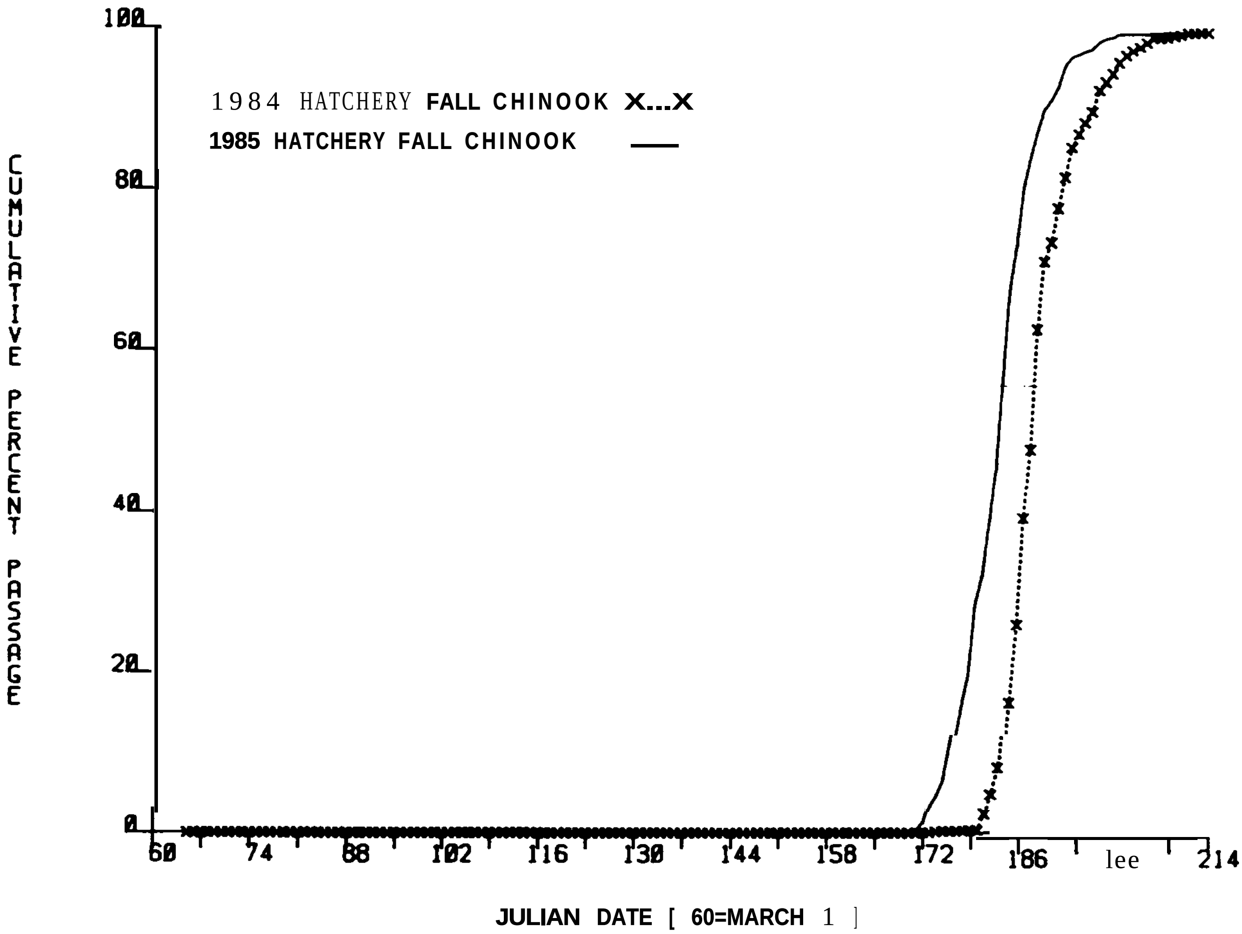


Figure 36. Cumulative percent passage past Prosser Dam of hatchery fall chinook smolts in 1984 and 1985.

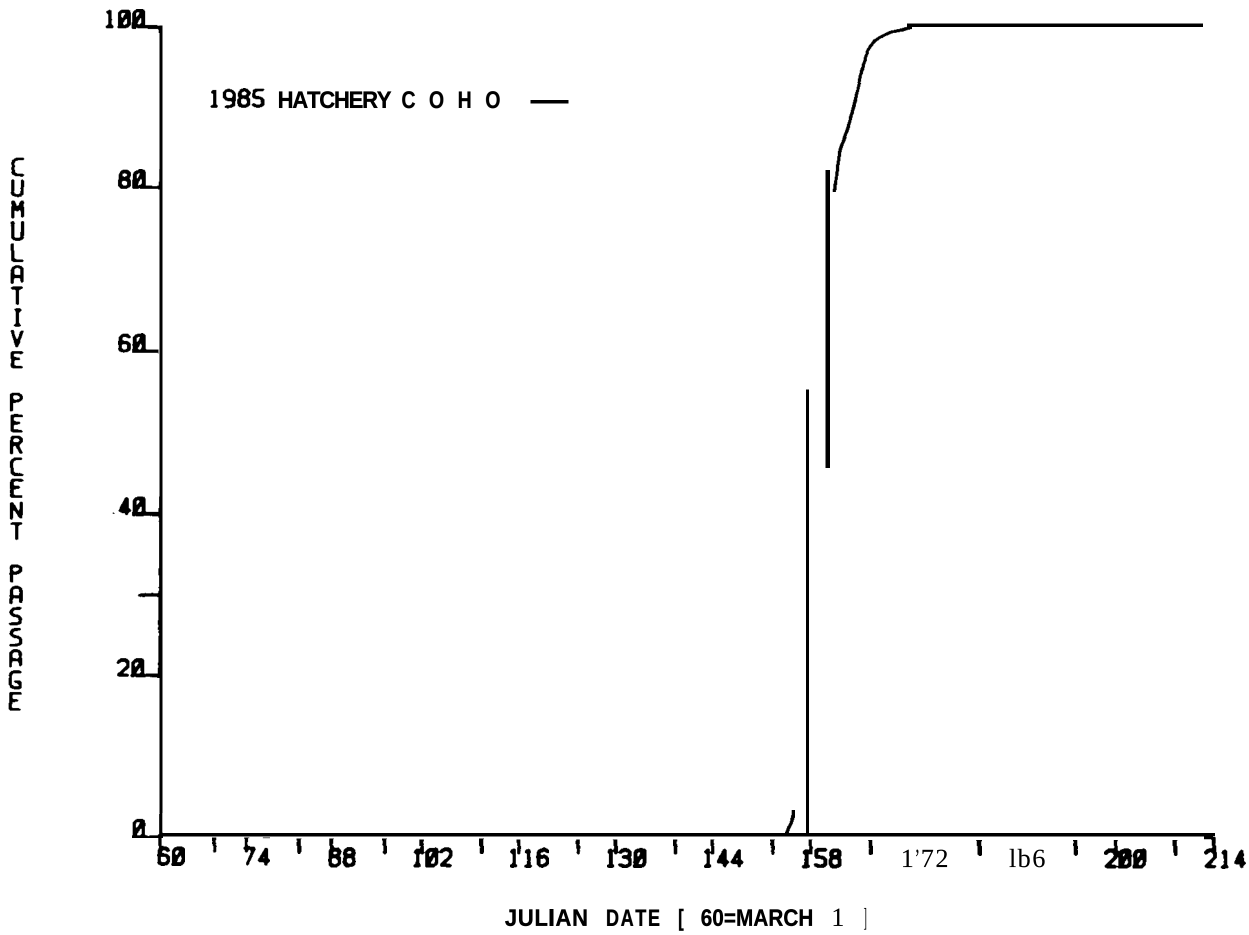


Figure 37. Cumulative percent passage of hatchery coho smolts past Prosser Dam in 1985.

Distance from the median release point to Prosssr Dam was approximately 64.4 miles, and the median travel time was 10.5 days. Speed of migration was therefore 6.1 miles per day, which is not unexpectedly high in light of the advanced release Jate.

Hatchery spring chinook smolts released into Rattlesnake Creek. On May 8, 25,000 branded hatchery spring chinook were released by the U.S.F.W.S. in Rattlesnake Creek at a point approximately S miles from its confluence with the Iiaches River. Of these fish 6,679, or 26.7 percent, were estimated to have migrated past Prosser. Outmigration timing is depicted in Figure 38. Dates of 50 and 75 percent passage were may 10 and May 19, respectively. The median travel time was therefore 32 days and, given that the distance from the release point to Prosser was 104.7 miles, the speed of migration was 3.3 niles per day.

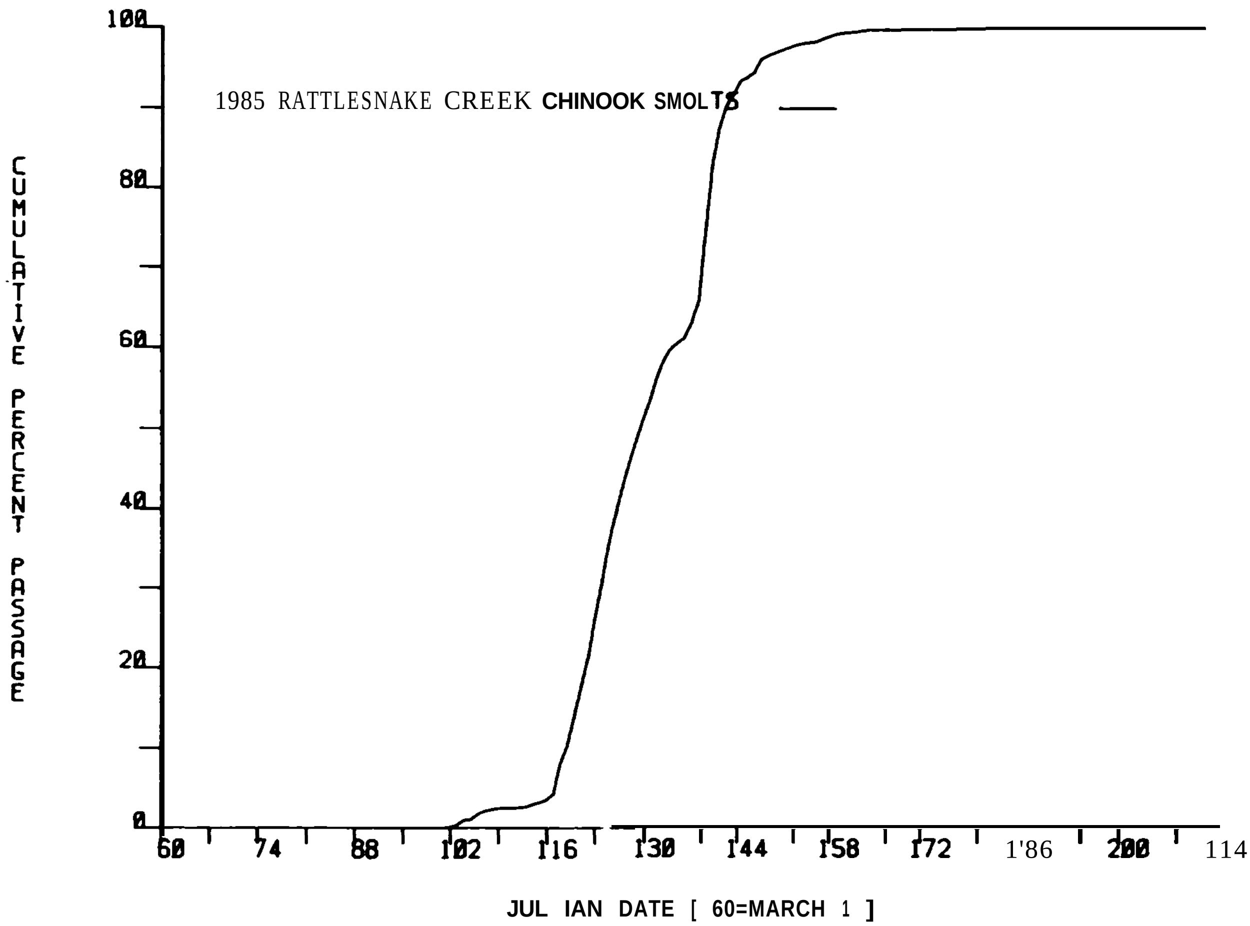


Figure 38. Cumulative percent passage past Prosser Dam of hatchery spring chinook smolts released into Rattlesnake Creek in 1985.

6 .1 .4 WAPATOX SMOLT TRAP

Wapatox smolt trap was in operation from April 1, **1985,** the **date** fish screens were installed in the canal, through Novmeber 10, 1985. the date fish screens vere removed from the canal. The total number of salmonids captured during this time period is presented in Table 33. A total of 8,799 spring chinook smolts and 26,651 pre-smolts were captured. Hatchery spring chinook smolts totaled 2,436 fish. Steelhead, both smolts and juveniles totaled 2,609 fish. The est imated outmigration, based on canal P.D.C., for each species is presented in Table 34. The estimated outmigration for spring chinook smolts and pre-smolts was 41,511 and 59,459 fish respect ivcly. Tile estimated outmigration of hatchery spring chinook snolts was 15,613. Tnc estimated outmigration of steelhead smolts and juveniles was 6,104 and **3,490** f ish respectively .

Not iceable periods of outmigration occurred during the spring **and** fall for both wild spring chinook and steelhead (Figure **39).** The onset of the smolt outmigrat ion occurred before the first sampling date on April 1 and continued through May . The highest period of outmigrat ion was from April 1 through April 14, **when** **29,497** fish were est imated to have moved past Wapatox (Table 34).

The est imated outmigration of pre-snolts in June and July totaled 524 fish. In August the movement of spring chinook showed an increase, with an est imated outmigration of 1,449 fish. A fall outmigration of pre-snolts began in September and peaked in October. An estimated 4,946 and 39,271 pre-smolts migrated in September and October respectively .

Table 33. Weekly raw catches of wild spring chinook, hatchery spring chinook and steelhead at Wapatox, 1985.

Date	Chinook spring	Chinook parr	Chinook hatchery	Steelhead
4/1-7	3,951	0		71
4/8-14	2,886	0	1,036	95
4/15-21	749	0	235	150
4/22-28	741	0	341	293
4/29-5/5	221	0	420	66
5/6-12	75	0	132	78
5/13-19	142	3	208	94
5/20-26	4	6	25	0
5/27-6/2	6	0	10	35
6/3-9	6	1	6	56
6/10-16	5	0	6	19
6/17-23	9	11	10	9
6/24-30 /A	4	10	3	11
7/1-7 /B	NA	NA	NA	NA
7/8-14 /C	0	5	0	2
7/15-21	0	10	1	1
7/22-28	0	17	0	6
7/29-8/4	0	59	3	10
8/5-11	0	406	0	20
8/12-18 /D	0	296	0	23
8/19-25 /E	0	109	0	20
8/26-9/1	0	109	0	35
9/2-8	0	126	0	23
9/9-15	0	655	0	101
9/16-22	0	171	0	14
9/23-29	0	315	0	5
9/30-10/5	0	131	0	41
10/6-12	0	1,011	0	105
10/13-19	0	1,595	0	122
10/20-26	0	10,401	0	261
10/27-11/2	0	7,754	0	782
11/3-9 /F	0	2,917	0	54
11/10	0	533	0	7
TOTAL	8,799	26,651	2,436	2,609

A Trap inoperable 6/28-30.
B. Trap inoperable 7/1-7.
C. trap inoperable 7/8-12.
D. Trap inoperable 8/18.
E. Trap inoperable 8/19-20.
F. Trap inoperable 11/7-8.

Table 34. Estimated weekly catches of wild spring chinook, hatchery spring chinook and steelhead at Wapatox, 1985; based on P.D.C. (percent discharged into canal).

Date	Chinook smolt	Chinook parr	Chinook hatchery	Steelhead
4/1-7	12,872			223
4/8-14	16,625		6,356	612
4/15-21	5,514		1,485	1,033
4/22-28	3,512		1,542	1,161
4/29-5/5	1,164		2,557	526
5/6-12	624		1,302	836
5/13-19	870	18	1,875	626
5/20-26	39	58	123	7
5/27-6-2	132	0	99	298
6/3-9	54	9	127	457
6/10-16	32	0	76	204
6/17-23	49	60	44	56
6/24-30 /A	24	59	14	65
7/1-7 /B	0	57	5	40
7/8-14 /C	0	48	3	28
7/15-21	0	14	1	15
7/22-28	0	26	0	14
7/29-8/4	0	86	4	14
8/5-11	0	583	0	27
8/12-18 /D	0	475	0	37
8/19-25 /E	0	239	0	27
8/26-9/1	0	182	0	54
9/2-8	0	219	0	37
9/9-15	0	2,740	0	439
9/16-22	0	628	0	52
9/23-29	0	1,264	0	17
9/30-10/5	0	429	0	82
10/6-12	0	1,489	0	142
10/13-19	0	2,247	0	158
10/20-21	0	21,515	0	484
10/27-11/2	0	16,017	0	1,596
11/3-9 /F	0	10,347	0	219
11/10	0	650	0	8
TOTAL	41,511	59,459	15,615	9,594
Steelhead Smolts				6,104

A. Trap inoperable 6/28-30.
B. Trap inoperable 7/1-7.
C. Trap inoperable 7/8-12.
D. Trap inoperable 8/18.
E. Trap inoperable 8/19-20.
F. Trap inoperable 11/7-8.

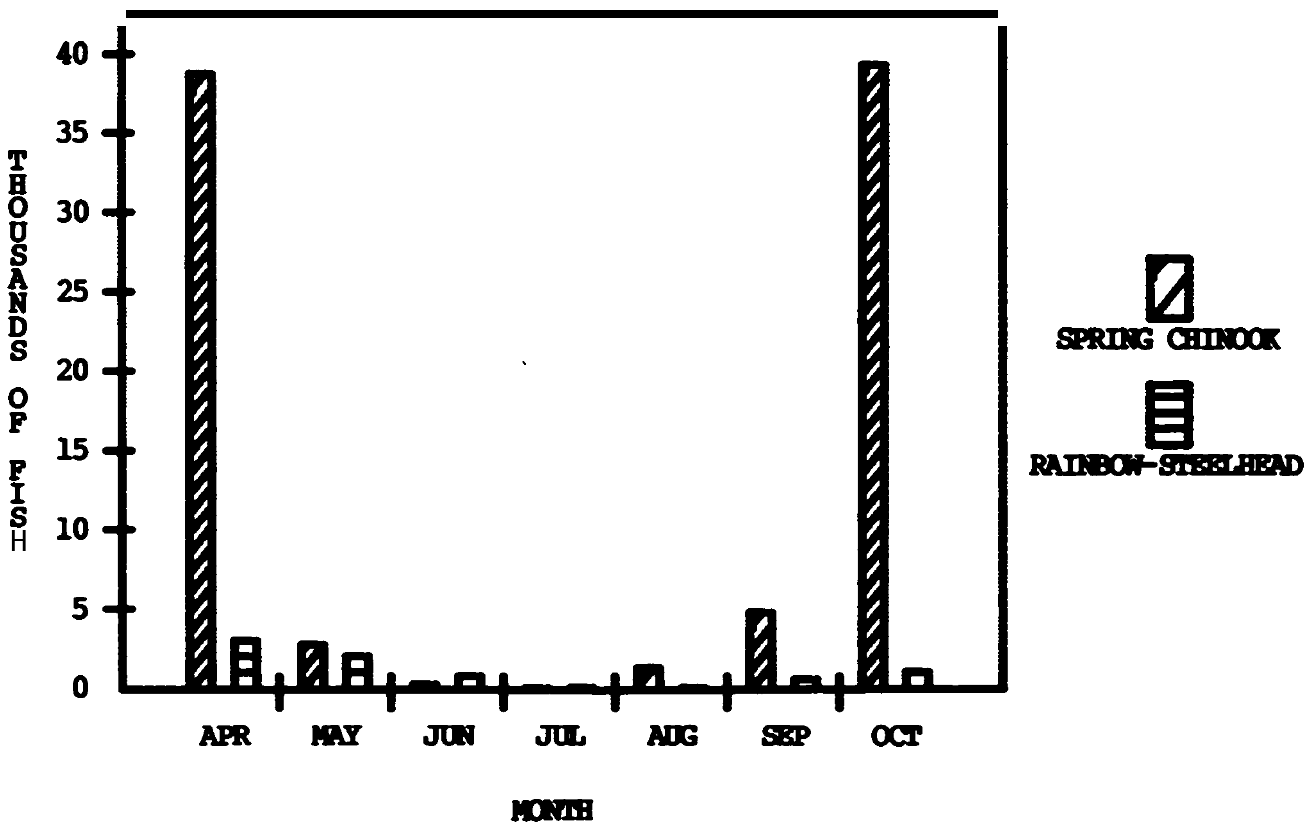


Figure 39. Estimated monthly outmigration of spring chinook and steelhead - rainbow trout at Wapatox in 1985.

Peak pre-smolt outmigration occurred from October 10 through November 2. The estinated outmigration during this period was 37,532 fish. Unfortunately, the fish screens were removed from the canal in early November, due to river ice, precluding further enumeration of the fall outmigration. For the first ten days sampled in November the estimated outmigration was 15,573 fish. Thus it appears that outmigration continued through November.

The spring outmigration for steelhead smolts also appears to have begun prior to trapping on April 1. Out-migration peaked between April 15 and April 28 which was approximately two weeks after peak enumeration of spring chinook. The estimated outmigration for his period was 2,194 fish. The steelhead spring outmigration extended through mid-June. Numbers of steelhead migrating remained low from June through August. Estimated outmigration for this time period was 1,126 fish. As observed with spring chinook the outmigration of steelhead pre-smolts increased during September and October. However the increase was not as large as that observed for spring chinook. Estimated outmigration was only 2,461 fish. Peak outmigration was from October 20 through November 2, with an estimated outmigration of 2,080 fish.

The downstream movement of pre-smolt spring chinook and steelhead in the Naches River is not unique to the Yakima River system. Downstream movement of pre-smolt spring chinook and steelhead during the fall-winter has been documented in the Salmon River drainage by Chapman and Bjornn (1969) They found that in several tributary streams juvenile chinook and steelhead outmigration began in early September and continued through November. In laboratory experiments Chapman and

Cjornn (1969) observed that 5.0 - 5.5 C was the water temperature at which steelhead showed decreased activity and began to move into the substrate. 3ustard end Narver (1975) observed in Carnation Creek, on Vancouver Island, B.C. that juvenile coho and steelhead moved closer to instream cover as the stream temperature decreased from 9 C to 2 C. The mean monthly stream temperatures at Wapatox for September, October and November were 12 C, 8 C and 4 C respectively. These were comparable to those Bjornn (1971) observed in the Lemhi River during the fall pre-snolt outmigration period. Chapman and Bjornn (1969) concluded that decreasing stream temperatures trigger the downstream movement of fish, as they seek out suitable habitat to over-winter further downstream.

From similar work on the Lemhi River in Idaho, Bjornn (1971) theorized that declining stream temperatures induce a "hiding behavior", where fish seek out suitable over-winter habitat. If adequate over-winter habitat can not be found fish then initiate a downstream migration to seek suitable habitat. This theory may apply to the Naches River as well.

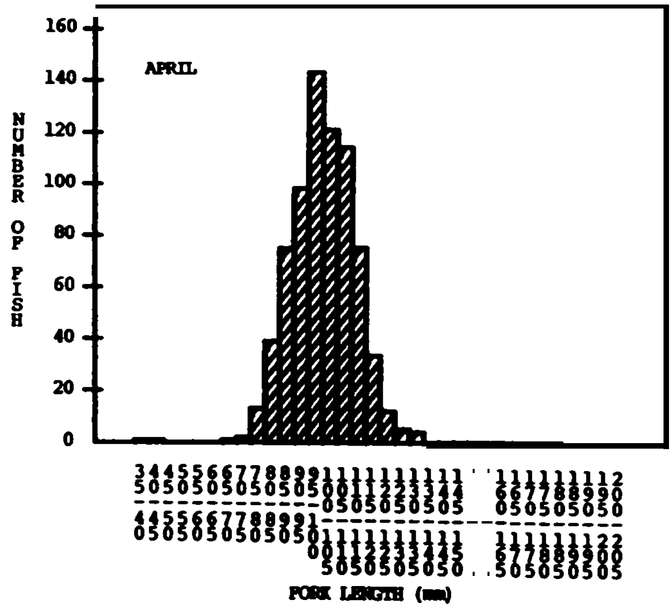
The Naches River appears to have less over-winter habitat than the Yakima River due its higher stream gradient and limited instream cover, such as root wads anti undercut banks. At present it's not known whether a fall outmigration of pre-smolts also occurs in the upper Yakima River.

Several hundred pre-smolts were cold branded at Wapatox this fall to determine if fish were outmigrating downstream into the lower Yakima River below Prosser. However, Prosser canal was closed because of extreme cold weather and we were unable to monitor the snolt trap. During the 1986 smolt outmigration fish will be examined for these marks.

Since Wapatox trap **could** not be operated prior to April 1, it is difficult to assess how large the spring smolt outmigration really was. However the estimated 59,459 pre-smolt chinook that migrated in the fall indicates that the fall outmigration of pre-smolts may be as large as the spring smolt outmigration. Chapman and Bjornn (1969) found that in several **Idaho** streams the fall-winter outmigration accounted for 50% of the total annual outmigration of both smolt and pre-smolts.

The monthly size distribution of wild spring chinook La presented in Figures 40, 41, 42 and 43. The mean smolt length in April was 100 mm. The mean smolt length increased in May to 107 mm. The first young-of-the-year fish were observed in May. These young-of-the-year ranged in length from 35-39nm. For August and September the mean f orb length averaged 85 mm. The mean fork length for October and November was 98 mm. The mean fork length for October and Novenber was only slightly smaller than the for;; length for April snolts.

The monthly size distribution of wild steelhead is presented in figures 44, 45, 46 an 47. The mean fork length for steelhead smolts in April was 163 mm. In May and June the mean fork length increased to 172 mm. Beginning in August and extending through October two distinct size classes were observed. The lower size class were young-of-the-year fish, while the upper size class were yearling fish. For August the mean fork length for the lower and upper size classes were 65 mm and 169 mm respectively. The mean fork length for September for the lower and upper size classes were 64 mm and 177 mm respectively.



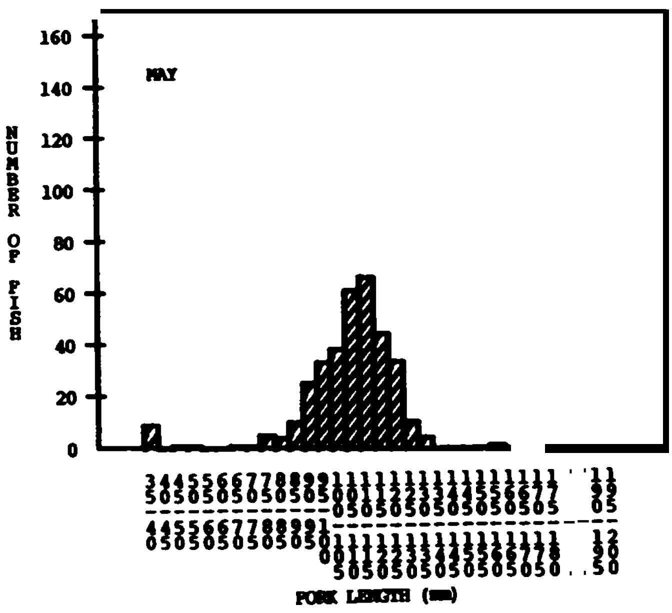


Figure 40. Monthly size distribution of wild spring chinook in April and May of 1985.

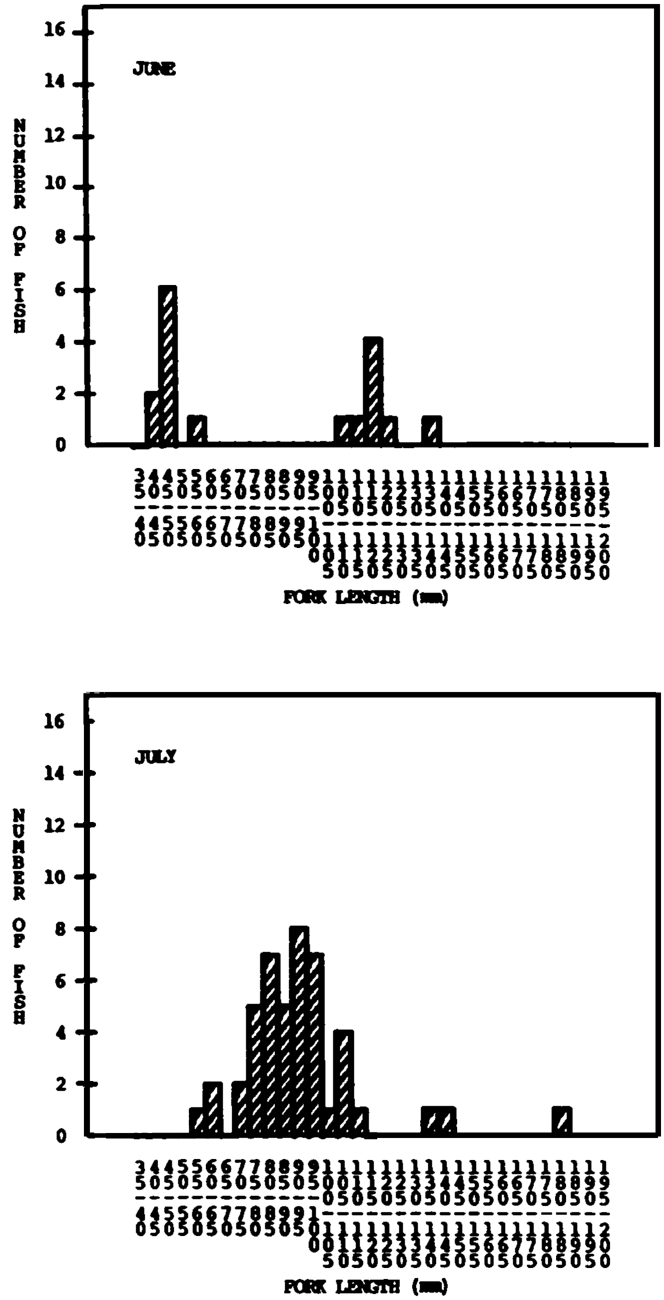


Figure 41. Monthly size distribution of wild spring chinook in June and July of 1985.

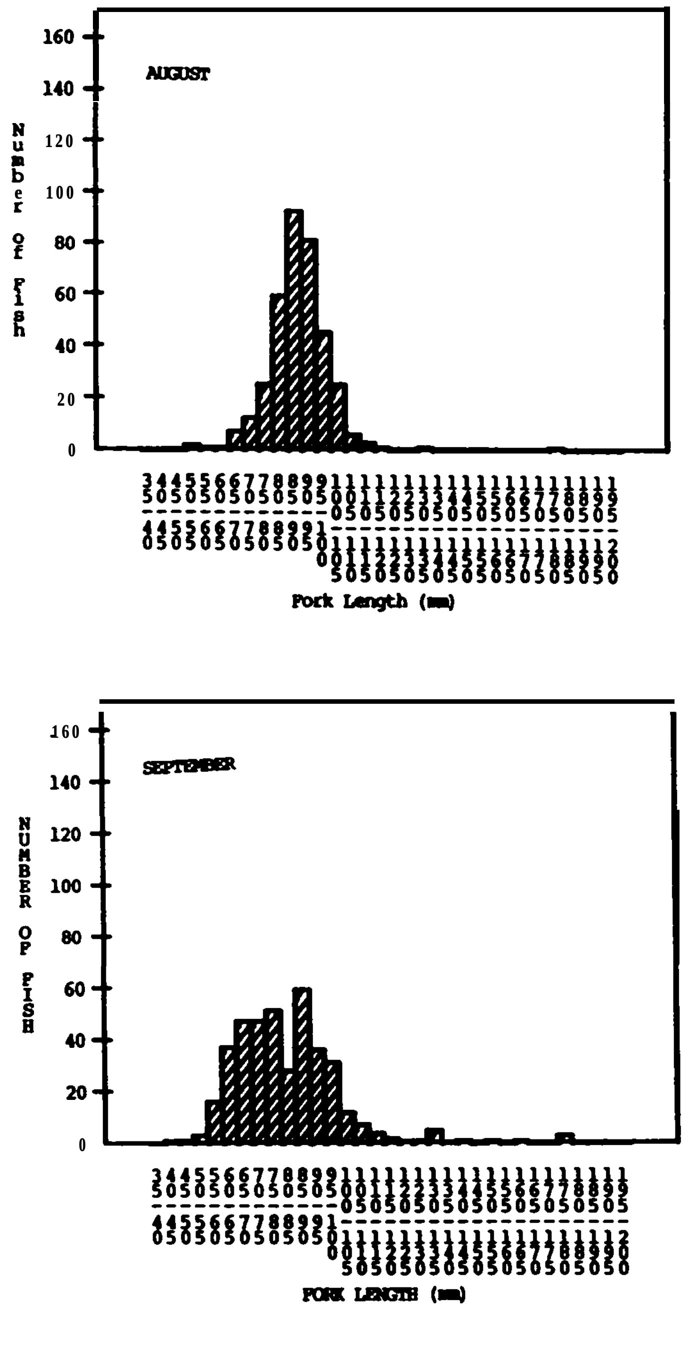


Figure 42. Monthly size distribution of wild spring chinook in August and September of 1985.

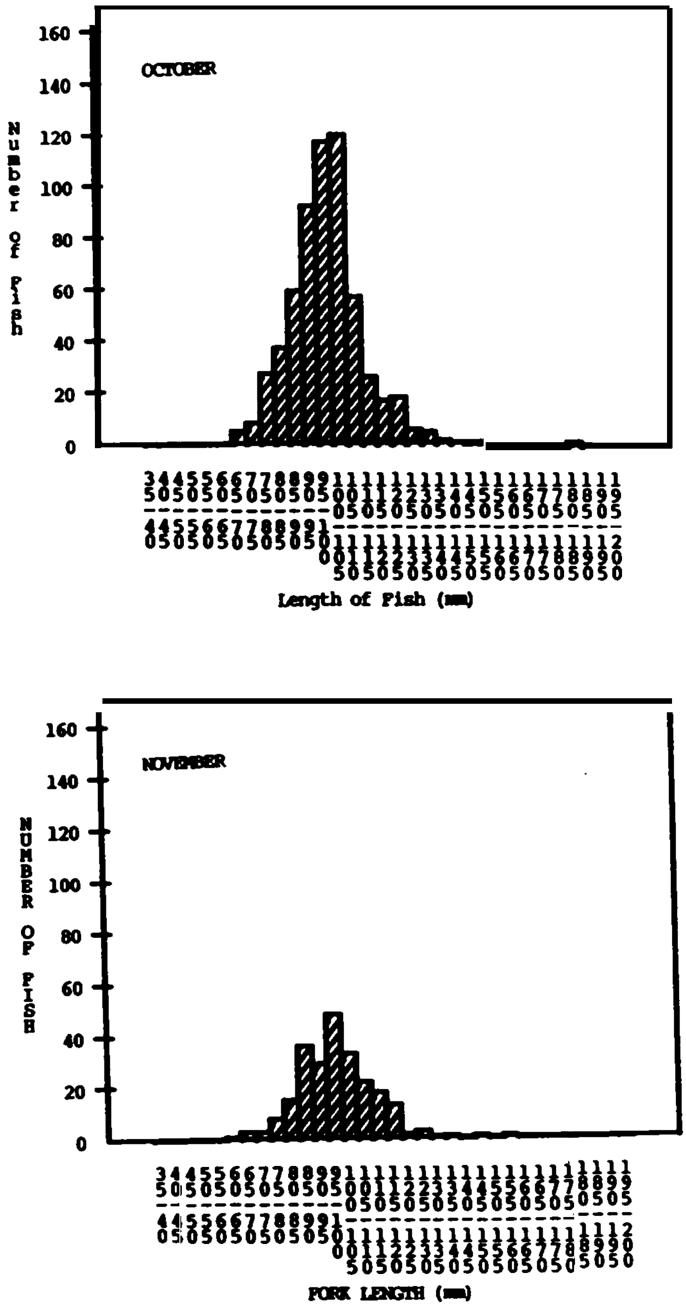
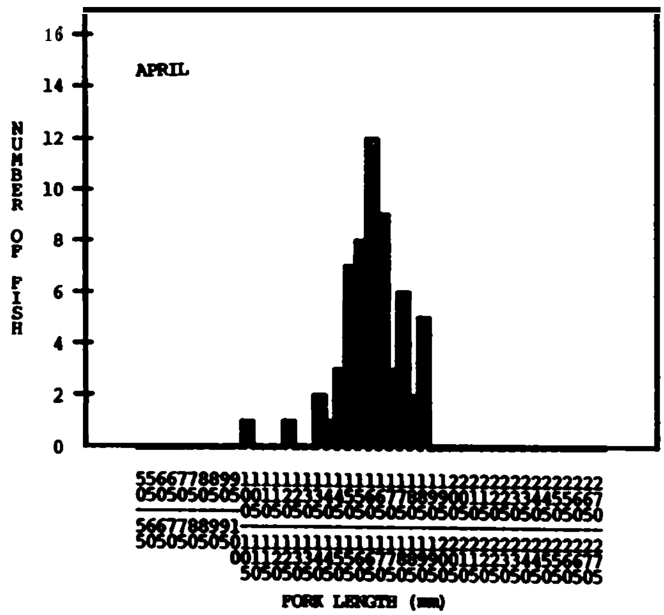


Figure 43. Monthly size distribution of wild spring chinook in October and November of 1985.



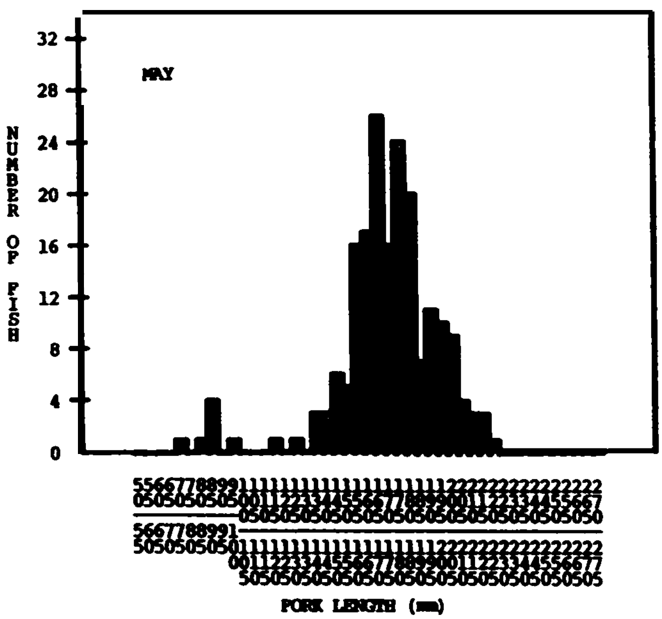
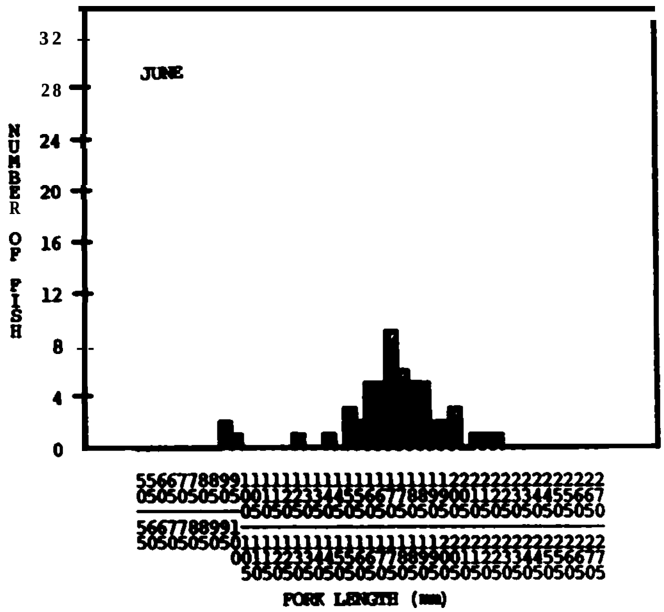


Figure 44. Monthly size distribution of wild steelhead-rainbow trout in April and May of 1985.



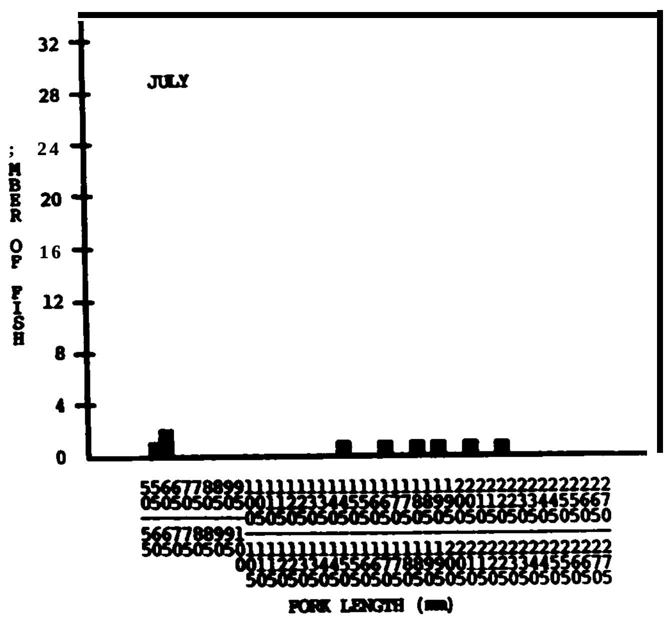


Figure 45. Monthly size distribution of wild steelhead-rainbow trout in June and July of 1985.

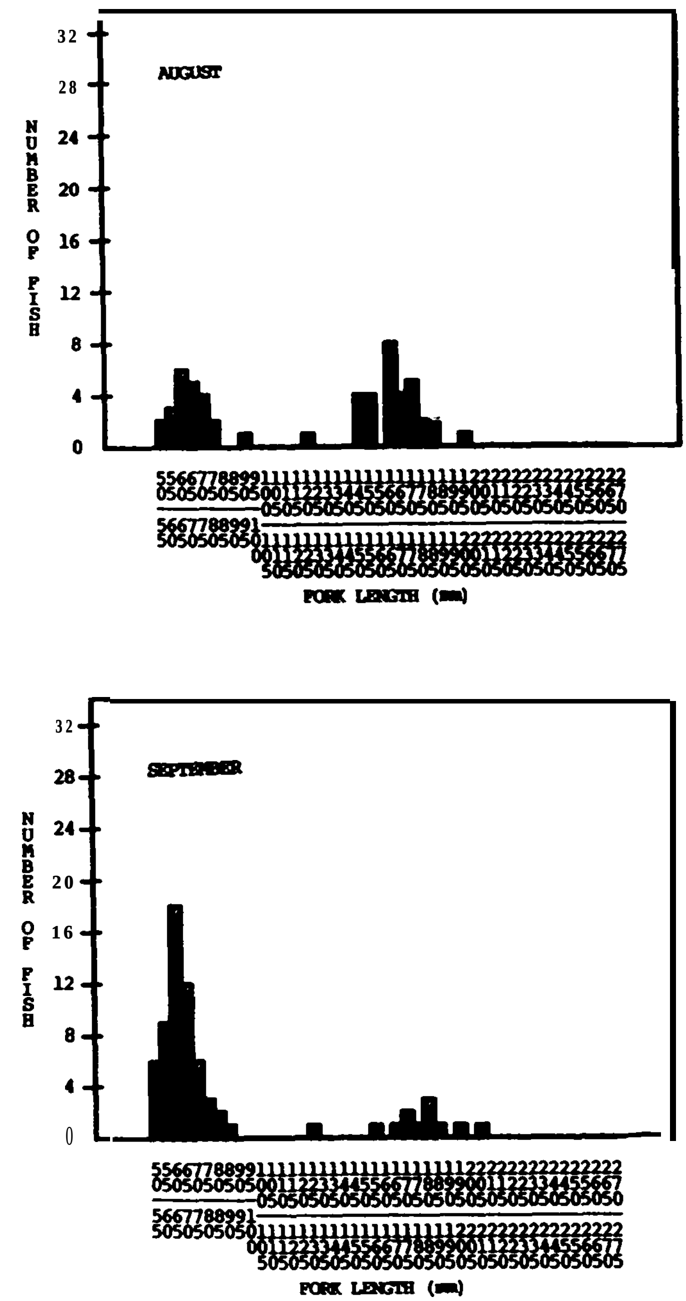


Figure 46. Monthly size distribution of wild steelhead-rainbow trout in August and September of 1985.

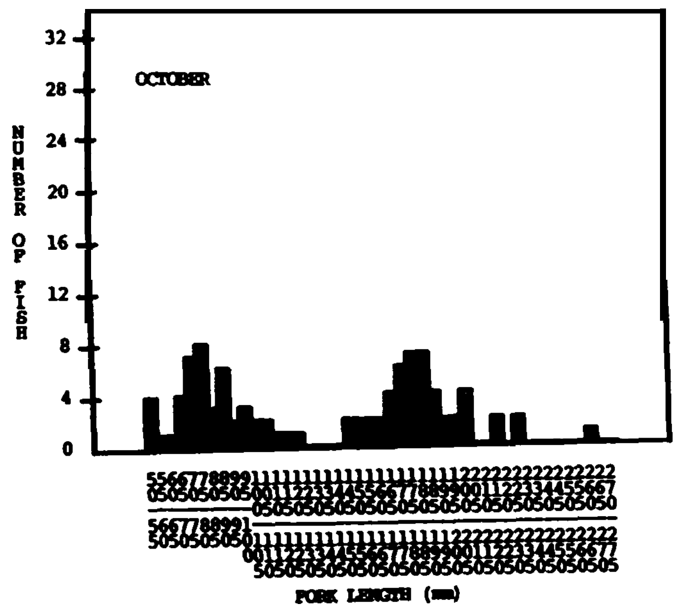


Figure 47. Monthly size distribution of wild steelhead-rainbow trout in October of 1985.

For October the mean fork lengths were 31 mm and 177 mm respectively. No length data was available for November.

The hatchery spring chinook smolts captured at Wapatox trap were from a release made on April 8 and 9 into upper Rattlesnake Creek, which enters the Naches River at RM 28. The release size was 25,794 fish. Based on the estimated number of smolts that outmigrated passed Wapatox trap the survival rate was 60%. Fifty percent of the smolts had migrated past Wapatox within the first two weeks after being released.

6.1.5 ADULT RETURNS

In 1985 a total of 3,783 adult and 423 jack spring chinook salmon returning to the Yakima River were counted at Prosser Fish ladder at RM 48 (Tables 35 and 36). This gives a total of 4,206 salmon returning to Prosser Dam (Table 37). The raw daily fish counts for Prosser Dam are presented in Appendix Table D.l. The mean dates of passage were May 27 and June 4 for adults and jacks respectively. An additional 321 fish were estimated to have been caught in the Yakima River subsistence dipnet fishery below Horn Rapids and Prosser Dams (Table 38). Therefore, total return to the Yakima system was 4,527 spring chinook salmon. This was the largest return of spring chinook salmon to the Yakima River in 19 years (Table 39).

Spring chinook were counted at Roza Dam from May 13 to September 30, 1985 (monitoring was continued through November by Bureau of Reclamation personnel but no fish were observed). Passage at Roza Dam was 2,125 adult and 239 jack spring chinook for a total of 2,364 fish (Tables 40, 41, and 42). A total of 97 adults were taken to the Lost Creek Brood stock holding facility for use in the brood stock evaluations. An additional 544 fish were harvested between Prosser and Roza Dams in the subsistence dipnet fishery (Table 38). Daily raw counts of fish passage at Roza Dam are presented in Appendix Table D.2. The mean dates of passage at Roza Dam were June 16 and June 29 for spring chinook adults and jacks respectively.

Table 35. Weekly adult spring chinook passage at Prosser Dam, 1985
(1) Index week number; (2) Week-ending date; (3) Weekly passage; (4) Weekly proportion; (5) Cumulative passage; (6) Cumulative Proportion

(1)	(2)	(3)	(4)	(5)	(6)
3	423	3	0.0008	3	0.0008
4	430	42	0.0111	45	0.0119
5	507	310	0.0819	355	0.0938
6	514	438	0.1158	793	0.2096
7		819	0.2165	1612	0.4261
8	5%	821	0.2170	2433	0.6431
9	604	826	0.2183	3259	0.8615
11	611	296	0.0782	3555	0.9397
12	618	126	0.0333	3681	0.9730
		61	0.0161	3742	0.9892
13	702	35	0.0093	3777	0.9984
14	709	4	0.0011	3781	0.9995
15	716	2	0.0005	3783	1.0000

Mean Date: May 27

Table 36. Weekly jack spring chinook passage at Prosser Dam, 1985
(1) Index week number; (2) Week-ending date; (3) Weekly passage; (4) Weekly proportion; (5) Cumulative passage; (6) Cumulative Proportion

(1)	(2)	(3)	(4)	(5)	(6)
4	430	1	0.0024	1	0.0024
5	507	4	0.0095	5	0.0118
6	514	4	0.0095	9	0.0213
7	521	28	0.0662	37	0.0875
8	528	102	0.2411	139	0.3286
9	604	162	0.3830	301	0.7116
10	611	64	0.1513	365	0.8629
11	618	39	0.0922	404	0.9551
12	625	7	0.0165	411	0.9716
13	702	11	0.0260	422	0.9976
14	709	1	0.0024	423	1:0000

Mean Date: June 4

Table 37. Weekly total spring chinook passage at Prosser Dam, 1985
(1) Index week number; (2) Week-ending date; (3) Weekly passage;
(4) Weekly proportion; (5) Cumulative passage; (6) Cumulative Proportion

(1)	(2)	(3)	(4)	(5)	(6)
3	423	3	0.0007	3	0.0007
4	430	43	0.0102	46	0.0109
5	507	314	0.0747	360	0.0856
6	514	442	0.1051	802	0.1907
7	521	847	0.2014	1649	0.3921
8	528	923	0.2194	2572	0.6115
9	604	988	0.2349	3560	0.8464
11	611	360	0.0856	3920	0.9320
12	618	165	0.0392	4085	0.9712
	625	68	0.0162	4153	0.9874
13	702	46	0.0109	4199	0.9983
14	709	5	0.0012	4204	0.9995
15	716	2	0.0005	4206	1.0000

Mean Date: May 28

Table 38. YIN Yakima River Spring Chinook Fishery, 1981 - 1985

Year	Estimated Chinook Run Size	Horn Rapids Harvests CH	Horn Rapids Harvests SH	Prosser Harvests CH	Prosser Harvests SH	Sunnyside Harvests CH	Sunnyside Harvests SH	Wapato Harvests CH	Wapato Harvests SH	Total Harvests CH	Total Harvests SH
1981	1,334	0	0	49	2	137	1	30	0	216	3
1982	1,686	10	0	78	0	241	11	105	2	434	13
1983	1,324	0	0	721		9	11		30	84	16
1984	2,677	3	0	116	4	122	18	48	3	28925	
1985	4,529	54	0	267	3	61	0	483	21	865	24
81-84 Average	1,775	3	0	79	2	127	lo	47	1	256	14

Table 39. Estimated spring chinook runs to the Yakima River Basin, 1957-1985.

YEAR	1/ TOTAL REDDS NACHES	YAKIMA	TOTAL	2/ESCAPEMENT	3/HARVEST	TOTAL RUN
1957	764	1216	1980	4752	7913	12665
1958	284	531	815	1956	4401	6357
1959	306	255	561	1346	3464	4810
1960	126	184	310	744	3668	4412
I.961	166	175	341	818	5044	5862
1962	153	76	229	550	4185	4735
1963	185	—		—	2992	—
1964	50	81	I.31	314	3241	3555
1965	53	90	143	343	1763	2106
1966	95	32	127	305	4800	5105
1967	58	97	155	388	3195	3583
1968	25	61	86	206	2430	2636
1969	50	309	359	862	618	1480
1970	48	23	71	170	1512	1682
1971	—	97	—	—	1232	—
1972	55	101	156	374	480	854
1973	28	41	69	166	3221	3387
1974	30	40	70	168	1748	1916
1975		104		—	600	—
1976	35	108	143	343	—	—
1977	10	121	I.31	314		—
1978	95	308	403	967	—	
1979	153	86	239	574		—
1980	113	353	466	1118	106	I.224
1981	172	294	466	1118	216	1334
1982	54	573	626	1252	434	16%
1983	83	360	443	1240	84	1324
1984	220	634	854	2050	289	2677 /4
1985	427	951	1378	3582	865	4527 /4

1/ Redd counts for 1957-1961 are total redd counts from Major and Mighell (1969). For 1962-1980 the counts are index counts from WDF or YIN coordinated surveys. Index counts in this time period were expanded by 1.8 and 2.5 for the Upper Yakima and Naches systems, respectively. (Expansion factors were derived from the ratio of index counts to total counts for the respective systems. Total counts were from the Major and Mighell study and from the 1981-1984 surveys.) For 1981-1984 the counts are total redd counts from USFWS, YIN, and WDF cooperative surveys.

2/ Based on Roza Dam counts the number of fish per redd has overaged 2.4 in the upper Yakima since 1982. Historical escapement for 1958 to 1981 was therefore estimated as the total redd count multiplied by 2.4. For 1982 to 1984 the actual number of fish per redd was used to expand the total redd count.

3/ 1957-1975 WDF tribal harvest estimates; 1980-1985 YIN tribal harvest

Table 40. Weekly adult spring chinook passage at Roza Dam, 1985
(1) Index week number; (2) Week-ending date; (3) Weekly passage;
(4) Weekly proportion; (5) Cumulative passage; (6) Cumulative Proportion

(1)	(2)	(3)	(4)	(5)	(6)
3	521	236	0.1111	236	0.1111
4	528	222	0.1045	458	0.2155
5	604	376	0.1769	834	0.3925
6	611	376	0.1769	1210	0.5694
7	618	281	0.1322	1491	0.7016
8	625	277	0.1304	1768	0.8320
	702	63	0.0296	1831	0.8616
1%	709	72	0.0339	1903	0.8955
11	716	55	0.0259	1958	0.9214
12	723	27	0.0127	1985	0.9341
13	730	62	0.0292	2047	0.9633
14	806	28	0.0132	2075	0.9765
15	813	23	0.0108	2098	0.9873
16	820	6	0.0028	2104	0.9901
17	827	6	0.0028	2110	0.9929
18	903	1	0.0005	2111	0.9934
19	910	5	0.0024	2116	0.9958
20	917	2	0.0009	2118	0.9967
21	924	7	0.0033	2125 /1	1.0000

Mean Date: June 16

1/ 97 of the 3783 fish were removed for brood stock by the BPA project; fish were trapped from 5/31 until 9/09.

Table 41. Weekly jack spring chinook passage at Roza Dam, 1985
(1) Index week number; (2) Week-ending date; (3) Weekly passage;
(4) Weekly proportion; (5) Cumulative passage; (6) Cumulative Proportion

(1)	(2)	(3)	(4)	(5)	(6)
3	521	3	0.0126	3	0.0126
4	528	3	0.0126	6	0.0251
5	604	5	0.0209	11	0.0460
6	611	28	0.1172	39	0.1632
7	618	41	0.1715	80	0.3347
8	625	62	0.2594	142	0.5941
9	702	25	0.1046	167	0.6987
10	709	29	0.1213	196	0.8201
11	716	16	0.0669	212	0.8870
12	723	5	0.0209	217	0.9079
13	730	12	0.0502	229	0.9582
14	806	7	0.0293	236	0.9874
15	813	0	0.0000	236	0.9874
16	820	0	0.0000	236	0.9874
17	827	0	0.0000	236	0.9874
18	903	2	0.0084	238	0.9958
19	910	0	0.0000	238	0.9958
20	917	0	0.0000	238	0.9958
21	924	1	0.0042	239	1.0000

Mean Date: June 29

Table 42. Weekly total spring chinook passage at Roza Dam, 1985
(1) Index week number; (2) Week-ending date; (3) Weekly passage;
(4) Weekly proportion; (5) Cumulative passage; (6) Cumulative Proportion

(1)	(2)	(3)	(4)	(5)	(6)
3	521	239	0.1011	239	0.1011
4	528	225	0.0952	464	0.1963
5	604	381	0.1612	845	0.3574
6	611	404	0.1709	1249	0.5283
7	618	322	0.1362	1571	0.6646
8	625	339	0.1434	1910	0.8080
9	702	88	0.0372	1998	0.8452
10	709	101	0.0427	2099	0.8879
11	716	71	0.0300	2170	0.9179
12	723	32	0.0135	2202	0.9315
13	730	74	0.0313	2276	0.9628
14	806	35	0.0148	2311	0.9776
15	813	23	0.0097	2334	0.9873
16	820	6	0.0025	2340	0.9898
17	827	6	0.0025	2346	0.9924
18	903	3	0.0013	2349	0.9937
19	910	5	0.0021	2354	0.9958
20	917	2	0.0008	2356	0.9966
21	924	8	0.0034	2364 /1	1.0000

Mean Date: June 17

1/ 97 adults of the 4206 fish were removed for brood stock by the BPA project; fish were trapped from 5/31 to 9/09.

A summary of adult and jack returns to each of the dams, harvest below and above Prosser, and the number of fish available to spawn in the Yakima and Naches Rivers is presented in Table 43.

The length frequency distribution of spring chinook salmon returning to the upper Yakima and the Naches Rivers is presented in Figures 48 and 49. As can be seen from these figures, there is no clear break between the four and five year old spawners. The Naches system has a proportionately larger number of larger fish but there is no vay of breaking the histogram down into age classes. This will be done as soon as sufficient scales have been analysed to aid in age class separation.

The spring chinook redd counts from 1981 to 1985 are presented in Table 44. These counts were not part of the data collected on the present spring chinook study but are important for estimates of survival through various life stages and are included in this report for that reason.

Upper Yakima Surveys: On 39 surveys on the Upper Yakima, 951 redds were reported. 860 vere above Roza Dam and an additional 91 vere discovered in the previously un-surveyed area betveen Rota Dam and Selah Bridge. Peak deposition vas in the Easton index area (50 redds per mile, 322 total).

Table 43. Total spring chinook salmon return to the Yakima River and to the spawning grounds in 1985.

Return to Prosser	
Adults to Prosser Dam	3,783
Jacks to Prosser Dam	423
Total run to Prosser	4,206
Harvest below Prosser	321
Total run to the River	4,527
Return to Roza	
Adults to Roza Dam	2,125
Jacks to Roza Dam	239
Total Run to Roza	2,364
Brood stock taken at Roza	97
Total number available to spavn in Upper Yakima	2,267
Harvest between Prosser and Roza	544
Fish spawning between Roza and Prosser1/	237
Number of fish available to spawn in the Naches River2/	964

1/ A total of 91 redds were discovered in the previously un-surveyed area between the Selah Bridge and Roza Dam. It was calculated that there are 2.6 fish per redd in the Yakima giving a total of 237 fish spawning belov Roza Dam in the Yakima River.

2/ Calculated as number of fish counted at Prosser, minus the harvest between Prosser and Roza minus the fish spawning in the Yakima below Roza minus the number of fish counted at Roza ladder.

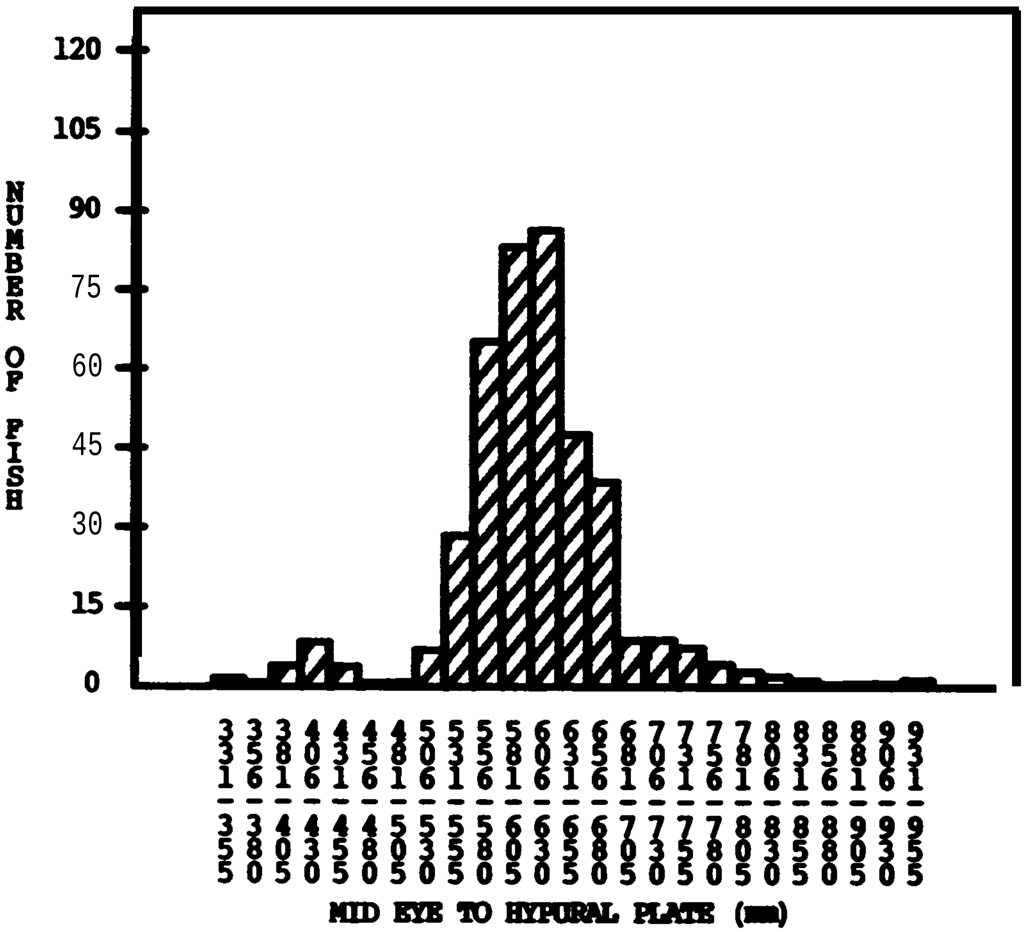


Figure48. Length frequency distribution of Yakima River adults in1985.

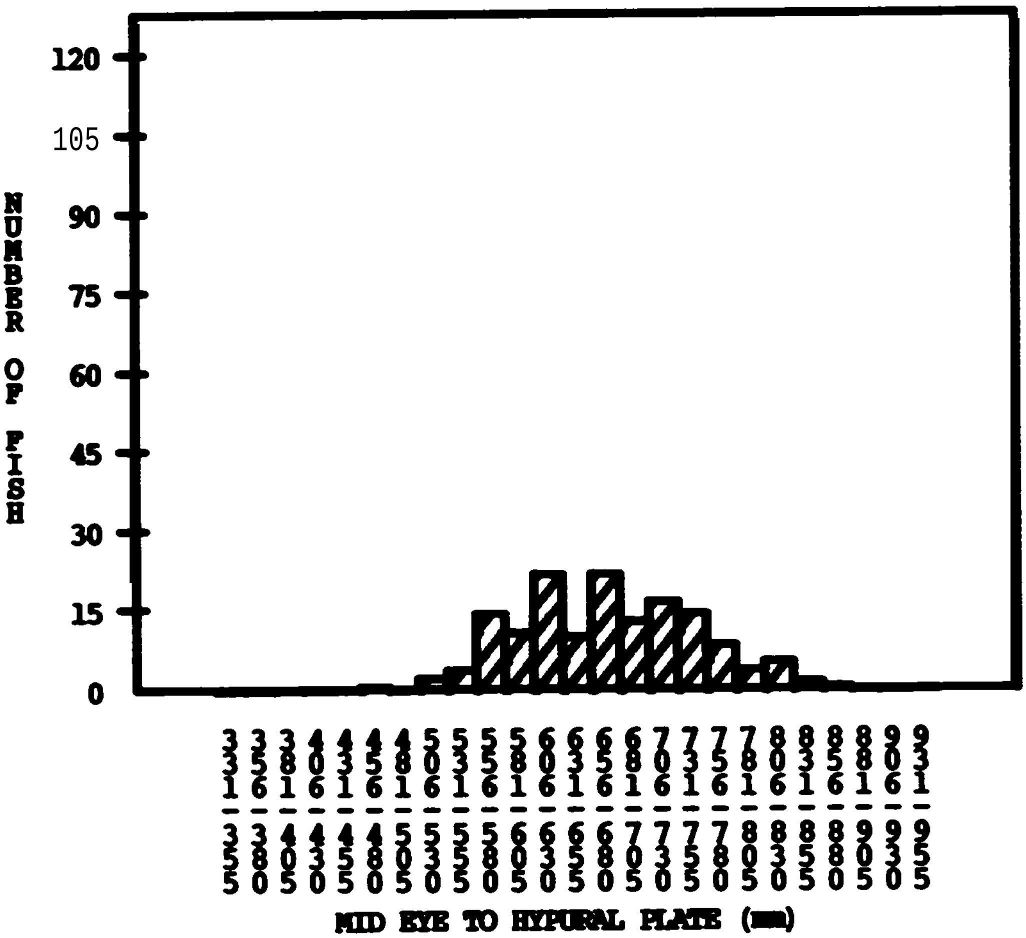


Figure 49. Length frequency distribution of Naches system adults in 1985.

Table 44. Yakima River Basin spring chinook redd counts, 1981 - 1985.

	1981	1982	1983	1984	1985
UPPER YAKIMA SYSTEM					
Easton	126	204	104	302	322
Game Ramp	35	92	32	66	77
Freeway Bridge	30	159	87	145	137
S. Cle Elum Bridge	39	80	77	67	118
Teanaway Reach	2	8 /1	20	9	22 /1
Ellensburg Town Ditch	5	—	25	11	17
Cle Elum River	57	30	15	31	153
Teanaway River	0	0	0	0	
Miscellaneous	—	—	—	3 /2	103 /3
Subtotal	294	573	360	634	951
NACHES SYSTEM					
American River	72	11	36	72	141
Bumping River	20	6	11	26	74
Little Naches River	16	2	4	41	44
Rattlesnake Creek	69	23	23	24	11
Naches River				57	157
Subtotal	172	54	83	220	427
Basin Total	466	627	443	854	1378

1/ Teanaway River to Thorp Bridge
2/ Manastash Creek (rm 0.0-4.6)
3/ Roza Dam to Selah Bridge - 91 redds; Washington Beef to Wilson Creek - 11 Redds

The number of fish per redd was calculated by dividing escapement above Roza by the number of redds deposited above Roza. The number of chinook escaping past Roza was 2,267; the number of redds was 860. The resulting statistic was 2.6 fish per redd. There is no accounting for pre-spawning mortality by this method, as such, 2.6 does not necessarily reflect the average number of fish observed on a redd on the spawning grounds.

Naches Surveys: There were 58 individual surveys on the Naches River in 1985 and a total of 427 redds were identified in the system. This represents the highest redd count on the Naches system since 1957. Substantial increases were observed in virtually all established spawning areas. Estimated escapement based on the redd count and the fish per redd statistic derived for the upper Yakima (2.6 fish per redd) was 1,110. Escapement based on calculations shown in Table was 964 and the fish per redd statistic calculated for the Naches from this data was 2.3.

6.1.6 ESTIMATES OF SURVIVAL THROUGH VARIOUS LIFE STAGES

6.1.6.1 Egg to Fry:

Survival from egg to fry was discussed extensively in the survival to emergence section of this report. The survival from egg to emergent fry was calculated to be 62.5% from six redds that were successfully capped in 1985.

Total egg deposition in the Yakima system from 1981 to 1985 is presented in Table 45. Total egg deposition was calculated as the sum of three subareas: the Upper Yakima, the American River, and the remaining Naches system due to different mean size of females in each of these areas. The mean fecundity as calculated from the length fecundity model and the mean length of females measured in each subarea in 1985 was 3,908 eggs/female in the upper Yakima, 6,198 eggs/female in the American River and 5,150 eggs/female in the rest of the Naches system. This length fecundity model predicts different egg numbers than the model used by Major and Mighell (1969) which was developed by Galbreath and Ridenhour (1964). Their model was based on spring, summer, and fall chinook collected in the lower Columbia River. If only the data for spring chinook from Galbreath and Ridenhour's model is used with the lengths reported by Major and Mighell (1969) the fecundity estimates would be closer to those reported in the current study.

The total number of fry produced from the egg deposition in 1981 to 1985 is reported in Table 46. This estimate is based on the current 62.5% egg to fry survival rate.

Table 45. Total estimated egg deposition in the Yakima basin for 1981 to 1985.

Brood Year	Subarea	Number of Redds	Eggs/Redd	Total
1981	American River	72	6,198	446,256
	Naches (other)	100	5,150	515,000
	Yakima (Upper)	294	3,908	1,148,952
	Total	466		2,110,208
1982	American	11	6,198	68,178
	Naches	43	5,150	221,450
	Yakima	573	3,908	2,239,284
	Total	628		2,528,912
1983	American	36	6,198	223,128
	Naches	47	5,150	242,050
	Yakima	360	3,908	1,406,880
	Total	443		1,872,058
1984	American	72	6,198	446,256
	Naches	148	5,150	762,200
	Yakima	634	3,908	2,477,672
	Total	854		3,686,128
1985	American	141	6,198	873,918
	Naches	286	5,150	1,472,900
	Yakima	951	3,908	3,716,508
	Total	1,378		5,189,408

Table 46. Estimated fry production from eggs deposited in the Yakima basin from 1981 to 1985.

Brood Year	Total egg deposition	% Survival	Total Fry
1981	2,110,208	62.5	1,318,880
1982	2,528,912	62.5	1,580,570
1983	1,872,058	62.5	1,170,036
1984	3,686,128	62.5	2,303,830
1985	5,189,408	62.5	3,243,380

6.1.6.2 Egg to Smolt:

The egg to smolt (S_{es}) survival was calculated as the number of smolts estimated to outmigrate past Prosser divided by the total egg deposition for their year class as calculated in Table 45. The egg to smolt survival from egg deposition for the brood years 1981 to 1983 and corresponding smolt outmigration years of 1983 to 1985 are presented in Table 47.

Table 47. Egg to smolt survival for 1981 to 1983 brood years in the Yakima basin.

Brood Year	Egg Deposition	Outmigrating Smolts	Percent Survival
1981	2,110,208	135,548	6.4%
1982	2,528,912	119,520	4.7%
1983	1,872,058	82,567	4.4%
mean	2,170,393	112,545	5.2%

This mean percent survival from egg to smolt of 5.2% is much lower than the 10.7% (range from 5.4 to 16.4) reported by Major and Highell (1969). This may possibly be due to an overestimation of the smolt outmigration by Major and Mignell due to their assumption that an equal volume of water over the dam contains an equal number of fish as water down the irrigation canal. A reevaluation of their data in our final report will attempt to resolve this difference. Bjornn (1978) evaluated natural production of spring chinook in the Lemhi River, Idaho, and over an 8-year period found that survival from egg to migrant smolt averaged 9.8% (range 4.0% to 15.9%). This is also much higher than the three year mean of 5.2% we found. He considered the level of spawning escapements to the upper Lemhi River low during the study years, thus underseeding may have resulted in maximum survival rates for juvenile chinook in that system.

Several other studies conducted on mid-Columbia tributaries had survival rates similar to those observed in the current study. In the Deschutes River, Oregon Johasson and Lindsay (1983) found an average egg-to-migrant survival rate of 3.5 percent (range 2.3% to 5.5%) for their spring chinook smolts. These were primarily yearling spring migrants but also included fall (age 0) migrants. An egg-to-migrant survival rate of 5.2% (range 3.6% to 6.7%) was found for spring chinook in the John Day River, Oregon, (Lindsay et al., 1981). These percentages were based on yearling spring migrants only.

6.1.6.3 Fry to Smolt:

An estimate of the survival from fry to smolt (S_{fs}) based on the fry production (Table 46) and smolt outmigration at Prosser for the brood years of 1981 to 1983 is reported in Table 48 .

Table 48. Estimated survival from fry to smolt in the Yakima Basin for brood years 1981 to 1983.

Brood year	Fry Produced	Smolt Out-migration	Percent Survival
1981	1,318,880	135,548	10.3%
1982	1,580,570	119,520	7.6%
1983	1,170,036	82,567	7.1%
mean	1,356,495	112,545	8.3%

6.1.6.4 Smolt to Adult:

The smolt to adult (S_{sa}) survival based on the 1983 smolt outmigration estimated at Prosser and the 1984 return of jacks (3 year old fish) and the 1985 return of four year old adults to the Yakima River is reported in Table 49. It was estimated that 3,572 wild three and four year old fish returned from an estimated smolt outmigration of 135,548 fish in 1983.

Table 49. Estimation of smolt to adult survival of the 1983 smolt outmigration from the Yakima system.

Adult (4 year old) Returns	
Total adult return (4's + 5's) to Prosser	3,783
plus adult harvest below Prosser	321
Total return of adult (4's + 5's) to system	4,104
Adults to Roza 1/	2,125
plus 237 (spawning below Roza) 2/	237
plus 361 (harvest above Prosser) 3/	361
Total adults to Yakima 4/	2,723
Adults to Naches 5/	1,198
plus 183 (harvest above Prosser) 6/	183
Total adults to Naches	1,381
times 50% (4 year old fish) 7/	691
Total four year old returns to system	3,414
plus Jacks that returned in 1984	248
Total 3 and 4 year old returns	3,662
minus hatchery fish	90
Total wild 3 and 4 year old returns	3,572
Wild Smolts outmigrating in 1983	135,548
Survival $(S_{sa}) = \frac{3{,}572}{135{,}548} =$	2.6%

1/ Total adults counted at Rota fish ladder.
2/ Spring chinook calculated to spawn in Yakima River below Roza dam from 91 redds at 2.6 fish/redd = 237 fish.
3/ Estimate of percentage of 544 spring chinook that were harvested above Prosser and below Roza that would have gone up Yakima. Based on 66.3% of adult run returning to the Yakima and 33.7% to Naches.
4/ Estimated that 100% of the adults in the Yakima are four year old fish.
5/ Estimated as total return of adults to system minus adult count at Roza minus spawning below Roza minus harvest between Prosser and Roza.
6/ Estimate of percentage of 544 fish harvested above Prosser and below Roza that would have returned to the Naches system (33.7%).
7/ Estimated that 50% of the adults in the Naches system are four year old fish.

This is an estimated survival from smolt to adult of 2.6%. This estimated rate of survival will increase with the addition of the five year old fish that will return in 1986.

This estimated rate of survival from smolt to adult is also subject to error due to our estimation of total outmigration. We are quite confident in the smolt outmigration estimation preceedure for Prosser (Section 6.1.3). However, from the recent findings at Wapatox Smolt trap indicating an extensive fall outmigration, and the preliminary findings on the Chandler Canal Entrainment study (Anonymous, 1985) indicating fish movement in January and February there may be a large outmigration of pre-smolt spring chinook in the months when the Chandler Canal Smolt trap is inoperable due to screen removal.

6.2 HATCHERY OPERATIONS

6.2.1 OUTPLANTING STUDIES

6.2.1.1 Pre-smolt releases

Releases of approximately 100,000 juvenile spring chinook (fry to pre-smolt) were scatter planted at twelve sites between RM 155 and 200 in the upper Yakima River in June, September, and November of 1985 to determine the optimum timing for hatchery releases. The release data for these three study groups is presented in Table 50. Similar releases were conducted in 1984. The survival of these pre-smolt releases to the Prosser juvenile trap is discussed extensively in the section on smolt trapping. The 1984 releases are expected to return as four year old adults in 1986 so survival from planting to adult return will be evaluated at that time.

6.2.1.2 Smolt releases

To evaluate the effectiveness of acclimating fish in earthen ponds and then allowing for a volitional release as smolts, one group of spring chinook smolts was released from Mary's pond at RM 190 on the Yakima River and a second group was transported from Leavenworth National Fish Hatchery and scatter planted directly into the upper Yakima River between RM 155 and 200. The release data for the 1985 acclimation pond and river released groups of smolts is presented in Table 51.

TABLE 50. Rearing, marking, and release data of spring chinook juveniles trucked to the Yakima River in June, September and November 1985.

Study Group	June Fry Release	September fingerlings	November Pre-smolts
Brood stock	Carson	Carson	Carson
Rearing Site	Leavenworth N.F.H	Leavenworth N.F.H.	Leavenworth N.F.H.
Rearing Facility	Raceway	Raceway	Raceway
Release Type	Trucked	Trucked	Trucked
Release Site	Upper Yakima River	Upper Yakima River	Upper Yakima River
Release Date	June 4, 1985	September 18-19,1985	November 19-20,1985
Total Number Released	100,750	101,724	95,431
Number Branded	9,102	10,489	10,526
Percent Branded	9.m	10.3%	11.0%
Brand Code	RAS(1)	LAS(1)	RAS(2)
Number with Ad-CWT	96,216	95,621	95,431
Tag Code	5-15-45	5-15-46	5-15-47
Tag Retention	95.5%	94.0%	94.0%
Size at Release	83mm 62/lb	111mm 22.9/lb	122mm 21.4/lb

TABLE 51. Rearing, marking, and release data of acclimation pond and river released spring chinook in 1985.

Study Group	Acclimation Pond	River Release
Brood Stock	Carson	Carson
Rearing Site	Leavenworth National Fish Hatchery	Leavenworth National Fish Hatchery
Rearing Facility	Raceway/Pond	Raceway
Release Type	Volitional Release	Trucked
Release Site	Marys Pond	Yakima River Ellensburg/Cle Elum
Release Date	April 12, 1985 *	April 10-12, 1985
Total number released	45,195	42,210
Number Branded	6,056	3,841
Percent Branded	13.4%	9.1%
Brand Code	LA2(3)	RAF(4)
Number Released with with Ad-CWT	43,297	40,436
Tag Code	5-15-33	5-15-32
Tag Retention	95.8%	95.8%
Size at release	127mm 19.7/lb	126mm 20.1/lb

* Fish were transported to Mary's Pond from Leavenworth National Fish Hatchery on April 1-3, 1985.

Similar releases were made from Nile Springs Pond and the upper Yakima River in 1983 and 1984. The survival of these release groups to Prosser is discussed extensively in the smolt trapping section of this report. The 1983 release groups returned as four year old adults in 1985 and their survival rates will be discussed in the Hatchery Adult Return section of this report.

6.2.2 BROOD STOCK EVALUATIONS

An experimental brood stock program was undertaken in 1984 and continued in 1985 to evaluate the effectiveness of using spring chinook adults from the Yakima River as a source of gametes for hatchery reared fish in an attempt to maintain the genetic components indigenous to the Yakima Basin. Crosses were made to obtain four different release groups; wild males and wild females, wild males and hatchery females, and two groups of hatchery males and females. The first three groups will be released in acclimation ponds and the forth group will be released directly into the Yakima River and compared with survival of group three - a continuation of the acclimation pond vs. river release study. The required crosses were made in 1985 from 97 Yakima River brood stock adults taken from the Roza adult trap. The hybrids will all be reared at Leavenworth National Fish Hatchery and released as smolts. The first releases, of the 1984 brood year products, will be made from Mary's Pond and the upper Yakima in 1986. The resulting progeny of the 1985 crosses will be released in 1987.

6.2.3 ADULT HATCHERY RETRUNS

Spring chinook adults from three different hatchery release groups were recovered in 1985. These fish were identified by the coded wire tags recovered in the Yakima Indian Nation Zone 6 ceremonial and subsistance fishery, the Yakima River ceremonial dipnet fishery, and from spawning ground surveys and carcass recovery surveys conducted on the Yakima and Naches River systems in September and October of 1985. A total of 1,296 fish were inspected for adipose fins and coded wire tags in 1985. Table 52 presents the release data for all hatchery groups that could possibly return to the Yakima system as three, four, or five year old fish in 1985.

Table 52. Tag data on all hatchery release groups that could have returned to the Yakima system in 1985.

Brood year	Tag Code	Total number released	Release site	Number tagged	Mark rate (%)
1980	5-10-41	100,050	Nile Springs	21,814	21.8
1980	5-10-61	401,714	Upper Yakima	45,523	11.3
1981	5-13-38	99,725	Nile Springs	94,529	94.s
1981	5-13-39	97,725	Upper Yakima	94,198	97.1
1982	5-11-47	29,636	Nile Springs	28,450	96.0
1982	5-11-48	45,552	Upper Yakima	41,573	97.7

The 1985 tag recoveries were from the 1982 release of 401,714 spring chinook smolts in the upper Yakima and the 1983 releases of 97,011 smolts in the upper Yakima and the 99,725 smolts from the Nile Springs acclimation pond. All tags recovered were expanded by the sample rate (fish sampled/total number of fish caught for a fishery or fish sampled/total number of spawners estimated in each river for spawner surveys) and by the mark rate or coded wire tag retention rate. This mark rate was only 11.3% in the 1983 release but was 94.8% and 97.1% for the two 1984 release groups. The expanded recoveries for each of the release groups is presented in Table 53.

The recoveries from the 1982 release group were returning as five year old fish and complete the data necessary to calculate the total survival (jacks, four-year fish, and five-year fish) from smolt to adult for that release. In 1984 it was estimated that 219 spring chinook returned as four year old aduits from the 5-10-61 release group (Wasserman et al., 1984). When this is added to the estimated 57 fish that returned in 1985 it gives a total of 276 adults returning from a release of 401,714 smolts. This gives a final smolt to adult survival rate of 0.069%.

The two 1983 release groups were from the Nile springs acclimation pond and smolts trucked and released directly into the upper Yakima River. The total number of smolts released for each group was similar with 99,725 from Nile Springs pond and 97,011 from the upper Yakima.

Table 53. Estimated expanded returns of hatchery released smolts.

Tag code	Source of recovery / 1	Number recovered	Sample rate /2,3,4,5	Sample expanded recovery	Mark rate	Total expanded recovery
5-13-38	1	2	.5046	4	.9480	4
	3	7	.1344	52	.9480	55
	Total					59
5-13-39	1	1	.5046	2	.9710	2
	2	1	.2948	3	.9710	3
	4	4	.1555	26	.9710	26
	Total					31
5-10-61	4	1	.1555	6	.1133	57
	Total					57

1/ Recovery code 1 = Zone 6 ceremonial and subsistence fishery; 2 = Yakima River dipent fishery; 3 = Naches spawner and carcass surveys; 4 = Yakima River spawner and carcass surveys.

2/ In the Zone 6 fishery 497 fish were inspected from an estimated harvest of 985 fish.

3/ In the Yakima dipnet fishery 255 fish were inspected from an estimated harvest of 865 fish.

4/ In the Naches system 155 fish were inspected from an estimated 1 ,153 spawners.

5/ In the Yakima River 389 fish were inspected from an estimated 2,501 spawners.

Nearly twice as many adults returned from the acclimation pond (59) as from the trucked release (31). Survival rates from smolt planting to adult for the acclimation pond and trucked fish are 0.05% and 0.03% respectively . Again, these survival rates will increase if any fish from these release groups return in 1986 as five year old adults.

In 1985 fish were visually examined for the presence or absence of an adipose fin as they passed over the counting board at Roza adult fish ladder. A total of 64 fish were observed to be missing the adipose fin (Table 54). This compares with the total of 83 fish calculated to be in the upper Yakima from Table 53. The timing of the hatchery fish run past Roza was very similar to the passage of wild fish with mean dates of passage of June 19 and June 17 respectively.

Table 54. Weekly passage of adipose clipped spring chinook at Roza Dam, 1985
(1) Index week number; (2) Week-ending date; (3) Weekly passage;
(4) Weekly proportion; (5) Cumulative passage; (6) Cumulative Proportion

(1)	(2)	(3)	(4)	(5)	(6)
3	521	1	0.0156	1	0.0156
4	528	14	0.2188	15	0.2344
5	604	6	0.0938	21	0.3281
6	611	12	0.1875	33	0.5156
7	618	10	0.1563	43	0.6719
8	625	7	0.1094	50	0.7813
9	702	3	0.0469	53	0.8281
10	709	2	0.0313	55	0.8594
11	716	1	0.0156	56	0.8750
12	723	2	0.0313	58	0.9063
13	730	3	0.0469	61	0.9531
14	806	1	0.0156	62	0.9688
15	813	1	0.0156	63	0.9844
16	820	0	0.0000	63	0.9844
17	827	1	0.0156	64	1.0000

Mean Date: June 19

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Appendix A

Emergent Fry Captures and Gravel Analysis

Appendix Table **A.1.** Captures of spring chinook **fry** in Yakim Rivre **emergence** trapr in 1985.

Calendar Date	Julian Date	**Eas ton** Ridge 1		Easton Ridge 2		Easton Ridge 3		Wart Nelron		Elk Meadow		Sun Country	
		total	cum	total	cum	total	cum	total	cum	**total**	cum	total	**cum**
3-28-85	87	0	0	0	0	0	0	0	0	0	0	0	0
4-01-85	91	0	0	0	0	0	0	0	0	0	0	1,077	1,077
4-01-85	92	1	1	0	0	0	0	0	0	0	0	126	1,203
4-05-85	95	0	1	0	0	0	0	0	0	0	0	114	1,317
4-08-85	98	0	1	0	0	0	0	0	0	0	0	4	1,321
4-09-85	99	0	1	0	0	0	0	0	0	0	0	4	1,325
4-10-85	100	0	1	0	0	3	3	0	0	0	0	2	1,327
4-12-85	102	0	1	4	4	19	22	0	0	0	0	20	1,347
4-18-85	108	24	25	32	36	2	24	0	0	0	0	0	1,347
4-l 9-85	109	0	25	0	36	242	266	0		0	0		1,347
4-20-85	110	0	25	42	78	230	496	0	8	0	0	8	1,347
4-22-85	112	33	58	0	78	13	509	0	0		0	0	1,347
4-23-85	113	22	80	0	78	29	538	41	41	8	0	0	1,347
4-24-85	114	9	89	8	86	14	552	12	53	0	0	0	1,347
4-25-85	115	22	111	0	86	3	555	13	66	0	0	0	1,347
4-26-85	116	0	111	0	86	21	576	3	69	0	0	0	1,347
4-27-85	117	0	111	0	86	20	596	5	74	0	0	0	1,347
4-2 9-85	119	125	236	38	124	16	612	75	149	0	0	0	1,347
5-01-85	121	169	405	17	141	0	612	10	159	644	644	0	1,347
5-02-85	122	23	428	3	144	23	635	86	245	211	855	0	1,347
5-03-85	123	16	444	6	150	10	645	400	645	167	1,022	0	1,347
5-04-85	124	0	444	0	150	0	645	85	730	75	1,097	0	1,347
5-06-85	126	741	1,185	243	393	515	1,160	14	744	668	1,765	0	1,347
5-07-85	127	302	1,487	388	781	43	1,203	15	759	603	2,368	0	1,347
5-09-85	129	31	1,518	259	1,040	22	1,225	51	810	172	2,540	0	1,347
5-10-85	130	128	1,646	112	1,152	9	1,234	5	815	61	2,601	0	1,347
5-13-85	133	355	2,001	450	1,602	11	1,245	9	824	124	2,725	0	1,347
5-l 4-85	134	30	2,031	129	1,731	17	1,262	0	824	11	2,736	0	1,347
5-l 5-85	135	28	2,059	87	1,818	0	1,262	18	842	14	2,750	0	1,347
5-16-85	136	77	2,136	40	1,858	5	1,267	400	1,242	7	2,757	0	1,347
5-17-85	137	239	2,575	31	1,889	10	1,277	903	2,145	69	2,826	0	1,347
5-20-85	140	94	2,469	21	1,910	7	1,284	289	2,434	26	2,852	0	1,347
5-21-85	141	14	2,483	21	1,931	2	1,286	123	2,557	10	2,862	0	1,347
5-22-85	142	18	2,501	7	1,938	1	1,287	8	2,565	0	2,862	0	1,347
5-24-85	144	28	2,529	4	1,942	1	1,288	11	2,576	1	2,863	0	1,347
5-28-85	148	11	2,540	0	1,942	0	1,288	3	2,579	0	2,863	0	1,347
5-31-85	151	10	2,550	0	1,942	0	1,288	47	2,626	0	2,863	0	1,347
6-03-85	154	0	2,550	0	1,942	0	1,288	0	2,626	0	2,863		1,347
6-06-85	157	0	2,550	0	1,942	0	1,288	0	2,626	0	2,863	8	1,347

Appendix Table A.2. Particle size for given d*values.

Site	Geometric Diameters (mm) d_5	d_{16}	d_{50}	d_{84}	d_{95}
Easton Ridge 1	.74	1.76	6.62	24.97	59.50
Easton Ridge 2	.83	1.8)	5.05	18.99	41.02
Easton Ridge 3	.84	1.93	6.09	24.44	78.22
Elk Meadows	.76	1.89	7.69	31.27	78.22
Sun Country	.70	1.74	7.00	28.12	69.79
West Nelson	.73	1.63	5.55	18.95	42.31

d* values are the particle diameters of which corresponding percentage of the sample is smaller than. Por example at Easton Ridge 1, 50% of the gravel sample is smaller than 6.62 mm.

Appendix Table A. 3. Percent finer than values per unit samples at given diameters Upper Yakima River, 1985.

Site	Sieve Diameters (mm) 75.0	26.5	13.2	9.5	6.7	3.25	1.70	.85	.425	,212
Easton Ridge 1	96.4	62.5	49.9	44.8	40.0	32.2	23.5	10.4	3.8	2.2
Easton Ridge 2	100.0	66.8	51.5	44.9	38.7	29.3	20.9	8.7	2.7	1.8
Easton	100.0	54.3	41.2	36.6	31.6	24.2	14.9	8.0	3.9	2.8
Sun country	93.5	68.0	54.1	48.2	41.3	30.0	17.8	8.4	5.4	3.9
Elk Meadows	95.5	66.7	53.3	46.8	39.8	30.9	17.6	2.8	3.6	2.8
West Nelson	100.0	65.2	53.1	46.6	41.4	32.7	16.5	7.9	4.9	3.7

Appendix B

Prosser Smolt Trap Efficiency Tests and Species Passage Data

Marked fish may spend a considerable period traversing the canal. Median canal residence time in 1984 and 1985 was roughly 3 days and 1 day, respectively. Some smolts took as long as 40 days in 1984 and 21 days in 1985. The canal represents an environment that differs substantially from the river. Relative structural heterogenity and habitat volume are reduced in the canal, and the rotary screens may represent another cause of stress or physical trauma. The intra-canal mortality rate is greater than that which 'occurs in the river possibly because of impingement on the screens and/or predatory mortality. Allowance must be made for intra-canal mortality vhen estimating trapping efficiencies at this site.

Trap efficiency vas estimated as the ratio of the number of recaptures of fish released in the river to the number of fish available for capture during the 2-7 day "base period" after release. The number of fish available for capture vas estimated as the product of the number of fish released in the river, the river survival rate, and a term representing the combined effects of intra-canal mortality and stress-induced migration lag.

The aforementioned approach entailed the following basic experimental protocol in 1984. Vigorous, uninjured fish vere removed from the trap and given a caudal fin clip and a distinctive freeze-brand the night before release. The brand designated whether fish were destined for release within the canal ("canal fish"), or in the river ("river fish"). River release sites vere 2.5 and 3.5 miles above the canal inlet ("2-mile" and "3-mile" releases, respectively).

Branded fish were held in 200 gallon plastic tanks which vere continuously aerated--both before and during transit to the release sites--by a l/4 h.p. air compressor fitted vith air stones: Surviving fish vere released the following morning betveen 0800 and 0900 hrs. Intra-canal releases vere made approximately 100 ft belov the inlet vhere intake turbulence had dissipated and the possiblity of fish being involuntarily svept back into the river vas minimal. River-released fish vere released from a boat in the middle of the river. Canal releases vere made from the sides of the canal. Only vigorous, actively swimming fish vere released.

The protocol folloved in 1985 vas similar but had four main modifications. First, branded fish vere held a minimum of 24 hours in a 10x8x4 foot flov-through holding tank. Second, intra-canal releases vere made several hundred yards belov the headgates, both in the morning and after dark. Third, on the day of a test release, a random sample of fish from all release groups vas placed in a 27 cubic foot nylon-mesh cage and monitored for mortalities for the duration of the test. Finally, river releases vere made only from the two-mile point.

The first modification represents an attempt to reduce the impact of handling stress on the migratory disposition and mortality of test fish. Mean pre-release holding time was about 2 days in 1985. Tvo days represents a compromise figure; it is long enough to allow some recovery from handling stress, and the culling of "weak" fish that would otherwise have died shortly after release, yet not so long as to generate confinement stress.

There were tvo major reasons for the modifications of intra-canal releases. The first was to eliminate the possibilty of canal fiah swimming upstream and out of the canal through the heed-gates, and the second w s to • 88eaa the magnitude of predator mortality in the canal. Water velocity from the headgate to the release point is about 4-7 feet per second. The probability of a smolt swimming • everel hundred yard8 against such a current is remote. Night releases vere made in an attempt to reduce losses from diurnal predatora - gull8 and squawfish - known to frequent the canal. If one assumes that the majority of predator losses occurs inediately after release, before smolts have had a chance to locate cover, then a capariaon of the survival of day and night canal releases ahould estimate predator losses.

The third modification vaa designed to assess stress-induced mortality in canal fiah by holding a random sample of fiah from each release group in a cage floating in the canal until the recapture of the laat teat fiah. This method possibly overestimated atreaa-induced mortality. Prolonged confinement of migrating smolts is itself a stressor, as is the deacaling and abrasion that reaulted from daily mortality checks vhen the cage was partially Pulled from the vater. In addition, a number of fish vere able to "gill" themaelves by forcing their head8 through the 3/8 inch mesh.

Finally, river releaser vere made only from the 2-mile point in 1985 because river mortality vas determined to be negligible in 1984.

The goal of this effort was to determine a relationship between efficiency end river discharge for spring chinook. Specific8117 it was hoped a statistically significant relationship between efficiency end the mean percent discharge diverted into the canal (P.D.C.) daring the base period could be developed.

Methods

Derivation of Estimator

Efficiencies were estimated over a 2 to 7-day base period by means of the following expreaaion:

$$E_i = \frac{C_{ri}}{R_{ri}\,(S_{ri})^x\,(C_{ci}/R_{ci})} \quad \text{equation 1}$$

Where E_i = estimated percent trapping efficiency for the ith release;

C_{ri} = total base period recaptures of river-released fish during the ith release;

R_{ri} - the number of fish released in the river during the ith release;

$(S_{ri})^x$ = river survival for the ith release;

(S_{ri}) = river survival per mile of river traversed in the ith release;

x = miles of river traversed;

(C_{ci}/R_{ci}) = an expreaaion representing the percent of river fiah that resumed migration during base period and, if entering the canal, aurvived passage through it in release i;

C_{ci} = the number of recapture8 of fish released in the canal during baae period in release i;

R_{ci} - the number of fish released in the canal in release i.

Assumptions, Justifications and Simplifications

Determination of Base Period. The base period vas restricted to no more than seven days because it was felt that vas sufficient time for the bulk of a release to move into the trap (or over the dam), yet not so long as to include different P.D.C. values and efficiencies. In 1984, 78 percent of all recaptures of canal-released fish, and 72 percent of all recaptures of river-released fish, occurred in the first veek. In 1985, 99 percent of all canal-released fish and 95 percent of all riverreleased fish were recaptured in the first week.

The base period vas never reduced from seven days unless such a period would have entailed unacceptably vide fluctuations in P.D.C., or unless the last river fishvas recaptured before the seventh day. The criterion for unacceptable fluctuation and subsequent base period truncation vas set at 25 percent of the mean P.D.C.; any period including a mean daily P.D.S. differing from the mean of the entire period by 25 percent or more vas truncated.

River Survival. "Tvo-mile" and"three-mile" releases vere exactly one mile apart. Assuming that canal survival, duration of migration and trapping efficiency vere equivalent for simultaneous 2- and 3-mile releases, the ratio of total percent recaptures for groups simultaneously released 3.5 and 2.5 miles above the canal should estimate the survival rate per mile in the river, Sri:

$$\frac{C_{3i}/R_{3i}}{C_{2i}/R_{2i}} = \frac{(R_{3i}(S_{ri})^{3.5}(S_{ci})\ E_i)\ /\ R_{3i}}{(R_{2i}(S_{ri})^{2.5}(S_{ci})\ E_i)\ /\ R_{2i}} = \frac{(S_{ri})^{3.5}}{(S_{ri})^{2.5}} = S_{ri}$$

where

S_{ri} = river survival rate per mile for the ith release;

S_{ci} = cumulative canal survival rate for the ith release;

C_{2i} and C_{3i} = total recaptures of fish released at "two-mile" and "three-mile" release points, respectively, from the ithrelease;

R_{2i} and R_{3i} = number of fish released at the tvo-mile and three-mile release points, respectively, on the ith release;

and E_i = the mean efficiency for the period over which all fish from the ith release were recaptured.

Three simultaneous 2- and S-mile releases vere made in 1984. Estimating S_{ri} as in equation 2 above, the values 0.847, 1.497 and 1.369 vere obtained. The most probable cause for such anomalous figures is that river mortality is quite lov relative to the variability of trapping efficiency. If the efficiency of a 3-mile release vere substantially greater than a 2-mile release due to random variability, small losses attributable to river mortality vould be obscured.

As mortality per river mile was apparently too lov to be detected by available techniques, it vas considered negligible, and the river survival term vas dropped from the eftrciency expression.

Net Base Period Migration gate Through Canal.

The percent of river fish that resumed migration during tne base period and survived passage through the canal was estimated as the ratio of base period recaptures of canal fish to the number of fisn released in the canal:

Net Base Period Migration gate = C_{ci}/R_{ci} equation 3

where C_{c1} = base period recaptures of canal fish in release 1;

R_{c1} = number of fish released in canal in release I.

This estimator is apparently accurate for canal fish because base period recaptures represents the proportion of the fish resuming migration and surviving canal residence and transit:

$$\frac{C_{c1}}{R_{c1}} = (M_{ci}) \ (S_{c,\ ci}) \quad \text{equation 4}$$

where M_{c1} = the percent canal fish resuming migration during base period in release i;

$S_{c,\ ci}$ = net survival of canal residence and passage for canal fish through base period in release 1.

Euqation 3 applies to river fish lt M_{ci} and $S_{c,\ ci}$ equal the corresponding flgures for river fish, M_{ri} and $S_{c,\ r1}$, or in the product of these variables is equal for canal and river fish. While there is some reason to believe that canal survival and base period migration rate may not be precisely equivalent for canal and river fish, the discrepancies between frgures for the respectivee groups are such that the product is probably comparable.

<u>Base period migration rate</u>. The temporal distributron of recaptures, and therefore the proportion of test fish that resumed migration during the base period ("base period migration rate") is quite similar for river fish and (day-released) canal fish. (Unless otherwise specified, the term "canal fish" always refers to chinook smolts released near the head of Chandler Canal during tne day-time). To reiterate, 78 percent of all canal fish and 72 percent of all river fish vere recaptured within a week of release in 1984. Comparable figures for 1985 are 99 and 95 percent, respectively. Two additional pieces of evidence suggest that the temporal recapture distribution of river fish is reasonably well reflected by canal fish. The first is that the extra distance traversed by river fish might not, of itself, entail a significantly retarded recapture distribution. The second is that there is no evidence of a significant delay associated with smolts finding the canal inlet.

A Kolmogorov-Smirnov (K-S) test of the recapture distributions of all P-mile and 3-mile releases, as vell as a test of all simultaneous 2-mile and 3-mile releases (which entail similar efficiencies), showed no significant differences. Thus, the extra mile that 3-mile fish travel on their way to the trap does not significantly delay their recapture distribution relative to 2-mile fish. It may also be reasonable to assume that the recapture distribution of fish released 2.5 or 3.5 miles above the canal might not be significantly delayed relative to canal fish solely because of the extra distance involved. The fact that acclimated hatchery spring chinook smolts in 1983 through 1985 migrated an from 7.5 to 4.4 miles per day in the Yakima River supports the contention that traveling several extra miles might not substantially retard the recapture distribution.

A delay in the recapture distribution of river fish relative to canal fish might occur if migrating river fish encountered Prosser Dam, avoided being spilled over the top, but still had difficulty finding the canal entrance. This possibility vas checked by a simultaneous release of smolts 100 feet inside the canal and in the river, approximately 200 feet upstream of the inlet, at a point where no visually perceptible current moved into the canal. If finding **the** entrance caused a delay, there should be a significant difference in the temporal distribution of recaptures between these groups. A K-S A test indicated no significant difference between the recapture distributions of fish released just above or just inside the headgates.

The recapture distributions of canal and river fish are not, however, equivalent. A **K-S** test of the recapture distributions of all river fish versus all canal fish was significantly different (alpha = .05) in 1984 and 1985. In both years the difference vas attributable to recaptures made on the day of release, when the proportional recapture of canal fish vas much greater than river fish. If the first day is excluded from analysis, the recapture distributions become statistically indistinguishable - i.e., a K-S test of the recapture distributions of combined 1984 and 1985 river fish does not differ significantly from canal fish.

The cumulative recapture percentages of pooled 1984 and 1985 river and canal releases are presented in Appendix Table B.l. Quite obvrously, the greatest ditference occurs on day one, in which the (apparent) outmigration of canal fish is 13 percent greater than river fish. The similarity of outmigration timing of canal and river fish after the tirst day is evident in Appendix Table B.2, a daily list of cumulative percent recaptures with the first day excluded.

The daily listing of the cumulative percent recaptures of river fish presented in Appendix Table B.1. represents the pooled data from 18 releases occurring over two years. This list vould represent the actual proportion of river fish that had resumed migration on any day after release under the folloving conditions:

Appendix Table B.1. Cumulative daily percent recaptures of chinook smolts released in the Chandler Canal (canal fish) or the Yakima River, 2.5 miles above Chandler Canal (river fish), in 1984 and 1985.

Day of Release	Cumulative Percent canal fish recaptures	Cumulative Percent river fish recaptures
1	64.1102	51.0261
2	73.9389	65.7793
3	79.3001	72.3794
4	83.0231	76.761
5	84.4378	80.1997
6	86.5227	83.7493
7	89.3522	86.1342
8	91.5116	89.1847
9	93.0008	91.5696
10	94.49	93.0671
11	95.3835	94.1209
12	96.3515	95.0083
13	97.3194	95.6739
14	97.7662	96.6722
15	97.9896	97.005
16	98.1385	97.3932
17	98.2874	98.0033
18	98.5108	98.1697
19	98.7342	98.3361
20	98.9576	98.6689
21	99.2554	98.7798
22	99.2554	98.9462
23	99.4043	99.279
24	99.5533	99.3344
25	99.6277	99.5563
26	99.7766	99.6118
27	99.7766	99.6118
28	99.7766	99.6118
29	99.7766	99.7227
30	99.8511	99.8336
31	99.8511	99.8891
32	99.9256	99.8891
33	99.9256	99.8891
34	99.9256	99.9445
35	99.9256	1.0
36	99.9256	1.0
37	99.9256	1.0
38	99.9256	1.0
39	99.9256	1.0
40	1.0	1.0

Appendix Table B.2. Cumulative daily percent recapture of chinook smolts released in the Chandler Canal (canal fish) or the Yakima River 2.5 miles above Chandler (river fish) in 1984 and 1985. Recaptures from the first day have been excluded, and cumulative percentages are based on remaining data.

Day of Release	Cumulative Percent river fish recaptures	Cumulative Percent canal fish recaptures
1	27.3859	30.1246
2	42.3237	43.6014
3	52.6971	52.5481
4	56.639	59.5697
5	62.4481	66.8177
6	70.3319	71.6874
7	76.3486	77.9162
8	80.4979	82.786
9	84.6473	85.8437
10	87.1369	87.9955
11	89.834	89.8075
12	92.5311	91.1665
13	93.7759	93.205
14	94.3983	93.8845
15	94.8133	94.6772
16	95.2282	95.923
17	95.8506	96.2627
18	96.473	96.6025
19	97.0954	97.282
20	97.9253	97.5085
21	97.9253	97.8482
22	98.3403	98.5277
23	98.7552	98.641
24	98.9627	99.094
25	99.3776	99.2073
26	99.3776	99.2073
27	99.3776	99.2073
28	99.3776	99.4338
29	99.5851	99.6602
30	99.5851	99.7735
31	99.7925	99.7735
32	99.7925	99.7735
33	99.7925	99.8868
34	99.7925	1
35	99.7925	1
36	99.7925	1
37	99.7925	1
38	99.7925	1
39	99.7925	1
40	1	1

1. That the rate of recovery from stress and reaquisition of migratory disposition vas constant for all releases; and
2. That there vas no net change in trapping efficiency on a given day of capture relative to the efficiency obtaining at release.

Canal Survival. Net base period migration rate through the canal is the product of rates of survival and mrgration. For canal fish, the survival term reflects both survival of canal passage and survival ot up to a veek's residence in the canal. For river fish, however, the term reflects transit of the canal and varying periods of residence in the river and tne canal. As over 90% of migrant smolts mwe through the canal at night, the losses occurring during canal passage are probably equivalent for river and canal fish. The difficulties of negotiating the rotary screens, finding the bypass ports and avoiding diurnal or crepuscular predators (squawfish, bass, anglers, gulls and herons) during a night passage should not differ because of migration being resumed inside or outside the canal. However, losses attributable to predation occurring before migration resumes may well be greater for canal fish, particularly on the day of release, vhen somewhat disoriented fish adjust to a new environment.

In two of three separate releases in 1984 and 1985, the survival rate of chinook smolts released 100 years above the bypass vas greater than the survival rate of fish released 200 yards below tne canal inlet. As mentioned, in two of 3 instances in 1984, the total percent of fish recaptured from releases 3 miles above the canal vas greater than for fish released 2 miles above the canal. Together, these results suggest that the hazards of traversing 1.5 miles of canal are substantially greater than 1.0 mile of river. Presumably, such a difference is due to greater predatory and/or traumatic mortality rates in the canal. Whatever the cause, one may assume survival per unit time is lover in the canal than the river. As canal fish reside in the canal continously until they migrate, their overall base period trans-canal survival rate is undoubtedly lover than the comparable figure for river fish.

The magnitude of the ditterence in base period canal survival for canal and river fish is not known, although the results of five special releases allov speculation. In an attempt to assess the impact of predators on day-released canal fish immediately after release, five groups of branded smolts vere released about 200 yards below tne canal inlet in the morning and the late evening (after dark) of the same day. The trans-canal survival rate of river fish could be estimated by total survival rate of the night-released canal fish if the following assumptions are made:

1. That virtually all river fish enter the canal after dark;
2. That the rate at which fish swim the lengtn of the canal (i.e., are recaptured), expressed as a proportion of the number of fish entering the canal on a given night, is the same for a group of entrained river fish and released canal fish; and

3. That, after the first night, there is no difference in the survival rates of those river fish and night-released canal fish that still remain in the canal.

Appendix Table B.3 lists the cumulative survival rates for these five day-night releases. In four of five comparisons, the survival of the night release was greater. If tne survival of night-time canal releases reflects the trans-canal survival rate of river fish, then this figure was on the order of 78 percent in May of 1985.

Appendix Table B.3. Cumulative survival of branded wild chinook smolts released in Chandler Canal in the morning and atter dark on the same day in May, 1985.

Release date	Cumulative survival day-release (percent)	Cumulative survival night-release canal (percent)
5/12/85	67.5	95.3
5/16/85	58.9	88.3
5/20/85	66.7	82.9
5/24/85	50.0	77.2
5/31/85	64.1	55.4
mean	61.4	78.2

<u>Accuracy of estimating net migration rate of river fish with canal fish</u>. Although day-released canal fish have a higher (apparent) emigration rate and a lover trans-canal survival rate than river fish, net migration rate may be comparable between groups because this term represents the product of base period emigration and survival rates. To the extent that the relative magnitudes of these opposed inter-group differences in migration and survival rates are equal, the products of

the terms will be equal.

Equality of the products of migration and survival rates for canal and river fish can be tested in the case of the five day-night releases in 1985 assuming:

1. That the survival of night-released canal fish accurately reflects the trans-canal survival of river fish; and
2. That the pooled daily cumulative percent recaptures of river fish in Table B.l accurately reflects the daily cumulative percent of river fish that have resumed migration.

Embodying these assumptions, an explicit comparison of net base period migration rate for canal and river fish is made in Appendix Table B.4.

The mean figure for net migration rate of river ;fish as calculated from recaptures of day-released canal fish is closely comparable to mean of the river fish estimates. Therefore, to the extent **that** it can be verified at the present time, the accuracy of the current method of calculating net base period migration rate - and efficiency - appears to be reasonable.

Some day it may be possible to operate a tyke net in the Yakima River below Prosser Dam and above the outflow from the smolt trap. If so, the proportion of a release of river fish that resumed migration during base period could be estimated directly, and net base period migration rate would be expressed as follovs:

Appendix Table B.4. Comparison of net base period migration rate, expressed as the product of base period migration percent and trans-canal sirvival rate, for reiver-reeased and canal-released spring chinook molts, May, 1985.

Date of release	Base period migration /1 (percent)	Canal survival (percent) /2	Net base period migration /3 (percent)
Day-Released Canal Fish			
5/12/85	1.0	.675	.675
5/16/85	.848	.589	.499
5/20/85	.991	.667	.661
5/24/85	.987	.500	.494
5/31/85	.970	.641	.622
mean			.590

Date of release	Base period migration /4 (percent)	Canal sumival (percent) /5	Ret base period migration (percent)
Estimate for River fish			
5/12/85	.837	.953	.798
5/16/85	.658	.803	.528
5/20/85	.802	.829	.665
5/24/85	.768	.772	.593
5/31/86	,861	.554	.497
mean			.612

1. Expressed as percent recaptures during base period.
2. Expressed as ratio of total recaptures to release number.
3. Also may be expressed as the ratio of total recaptures of day-released canal fish during base period to release number.
4. Assumed equal to figures in list of pooled daily river fish recaptures in Table B.l.
5. Assumed closely comparable to survival of night-released canal fish.

$$\text{Net base period migration rate} = \left[\frac{C_{RT,BP}+C_{RF,BP}}{C_{RT,TOT}+C_{RF,TOT}}\right]$$

vhere $C_{RT,BP}$ = the catch of river fish in the smolt trap during base period;

$C_{RF,BP}$ = the catch of river fish in the fyke net in the river below Prosser Dam during base period;

$C_{RT,TOT}$ = the total catch of river fish in the smolt trap;

$C_{RF,TOT}$ = the total catch of river fish in fyke net in the river below Prosser Dam;

$$\left[\frac{C_{RT,BP}+C_{RF,BP}}{C_{RT,TOT}+C_{RF,TOT}}\right] \left(\frac{C_{CN,TOT}}{RCN}\right)$$ = the percent of a group of river fish resuming migration during base period;

equation 3

$C_{CN,TOT}$ = the total catch of night-released canal fish;

R_{CN} = the number of fish released into the canal at night;

$\left(\frac{C_{CN,TOT}}{R_{CN}}\right)$ = the estimated trans-canal survival of river-fish.

Appenaix Tables B.5 and B.6 summarize the main results of releases in 1984 and 1985, Appendix Tables B.7 and B.8 list the daily recaptures of 1984 and 1985 releases. Three points are evident from these tables. First, the combined data from 1984 and 1985 span a wide range of diversions into the canal (24.4 to 78.4 percent). Second, the tour tests involving simultaneous releases of steelhead and chinook resulted in closely comparable efficiency estimates. Finally, Tables B.7 and B.8 indicate that the speed of outmigration of fish released in 1985 was greater than in 1984.

Two tactors probably contributed to the accelerated movement of test fish in 1985. In 1985 there were functional exit ports both on the floor of the canal and near the surface, whereas only the canal-floor exits were functional in 1984. One would expect the recapture distribution of test fish in 1984 to reflect whatever reluctance smolts may have had in sounding the 12 to 14 feet necessary to reach bottom exits. In addition, 1985 releases were, on average, about two weeks later than in 1984. Smolts are known to migrate more rapidly as spring progresses and the relatively protracted recapture period for 1984 releases is not unexpected.

The P.D.C.-efficiency data from both years was fit to a logistic relationship with the aid of a non-parametric computer program. Linear, log, power and exponential regressions were run as well. The best regession of P.D.C. on efficiency was provided by the logistic fit, althrough the linear relationship was a close second. The residual sum of squares was 3,873 for the logistic fit and 4,131 for the linear regression (see Appendix Figure B.l.).

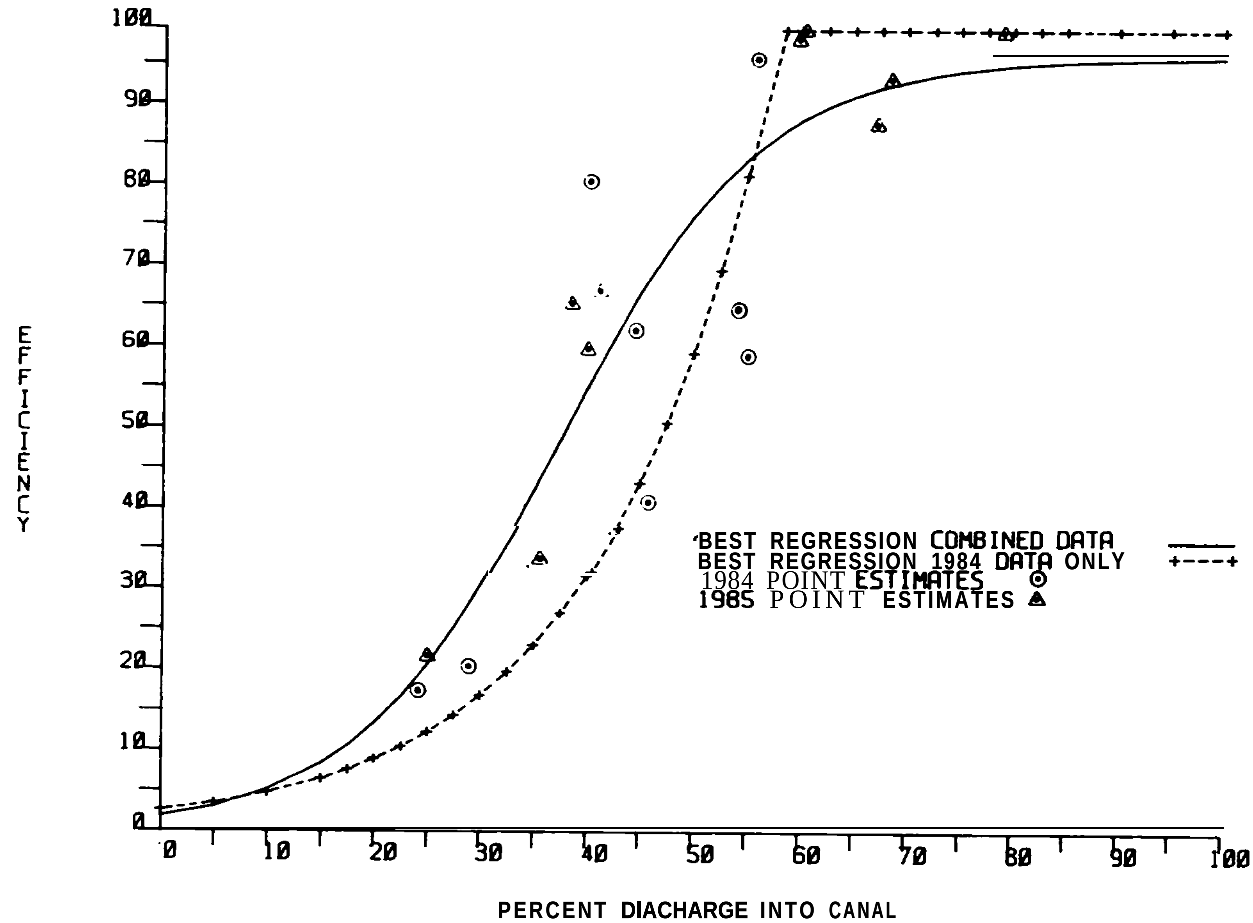


Figure B.l. Best regressions of percent discharge into canal on efficiency in 1984 and 1985.

Appendix Table B.5. Summary of 1984 efficiency tests at Chandler Canal.

Release number 1/	Species	Date	Number of canal fish released	Dumber of river fish released	Base perrod length	Base period P.D.C.	Efficiency
1.	Spring chinook	4/10/84	198	358	7 days	45.5	40.6
3.	Spring chinook	4/17/84	118	270	7 days	40.5	81.2
5.	Spring chinook	4/20/84	167	530	7 days	43.8	62.2
5.	Spring chinook	4/27/84	215	598	7 days	53.9	58.9
6.	Spring chinook	4/29/84	138	197	7 days	53.2	63.9
10.	Spring chinook	5/11/84	79	105	3 days	54.6	96.7
10.	Steelhead	5/11/84	70	120	3 days	54.6	91.1
11.	Spring chinook	5/15/84	100	95	4 days	29.0	20.4
11.	Steelhead	5/15/84	70	99	1 day	29.0	27.2
12.	Spring chinook	5/22/84	31	89	7 days	24.4	11.6

1/ Releases 2, 8, and 9 were exclusively intra-canal, while data from release 7 was discarded due to errors in brand readmg.

Appendix Table B.6. Summary of 1985 efficiency test at Chandler Canal.

Test number	Species	Date	Pre release holding time(days)	Number released canal day	canal night	river	Base period (days)	Mean P.D.C.	Efficiency (percent)
1.	Spring chinook	4/20/85	l-3	55	- -	193	3	35.4	33.0
2.	Spring & fall chinook	5/2/85	1-2	87	---	204	2	67.4	87.0
2.	Steelhead	5/2/85	1-2	157	---	237	2	67.4	90.3
3.	Spring & Fall chinook	5/9/85	1-2	197	---	224	2	78.4	100 /1
	Steelhead	5/9/85	1-2	201	---	225	2	78.4	100 /2
2:	Spring & Fall chinook	5/12/85	1-2	126	106	235	6	67.4	95.2
5.	Spring & Fall chinook	5/16/85	2	112	142	199	2	59.3	100 /3
6.	Spring & Fall chinook	5/20/85	3	194	199	232	5	39.7	58.7
7.	Spring & Fall chinook	5/24/85	1	158	114	300	4	3r.4	66.2
8.	Spring 6 Fall chinook	5/26/85	1-2	116	---	1/8	3	40.5	66.5
9.	Spring & Fall chinook	5/31/85	2	103	92	198	7	59.1	99.2
10.	Spring & Fall chinook	6/8/85	4	74	---	117	4	25.7	20.5
10.	Coho	6/8/85	4	74	---	141	4	25.7	2U.5

1/ ana 2/ Actual calculations gave chinook efficiency as 109.6% and Steelhead efficiency as 102.2%. These values were assumed to reflect inherent imprecision of estimator and were set at 100.0%.

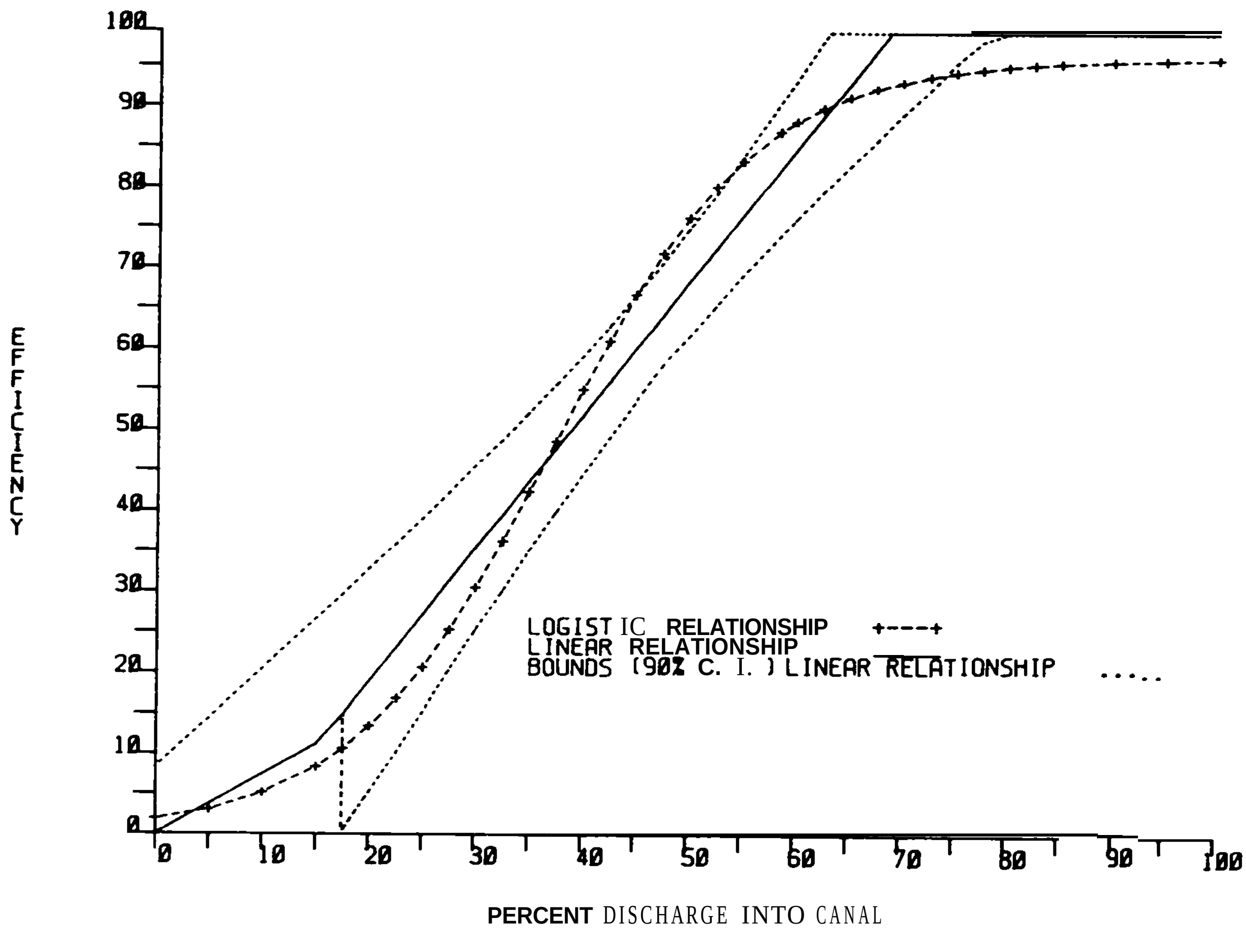
3/ Actual calculations gave an eftrciency of 130.6%. This value probably resulted from inadvertant stress on dapreleased canal fish prior to release: accidental partial dewatering of holding tank left diay-release canal fish partially stranded for several hours, causing a prerelease mortality of 14.1% (compared to 3.1% for river fish). If relatively more day-released canal fish suffered stress-induced mortality after release, the efficiency estimator woula be erroneously inflated. If one allows for a stress-induced survival rate among day-released canal fish 76.5% as great as for river fish, efficiency would be estimated at 100.0%. The pre-release survival rate ratio of day-released canal fish to river fish was 88.6%. The similarity of this figure to 76.5% constituesa the justification for assigning an efficiency of 100%.

There are biological reasons to expect a logistic relationship between P.D.C. and efticiency. When P.D.C. is high, the depth of the water column as it spills over the dam is quite small and over many sections of the dam there is no spill at all. In addition, the thalweg of the river is shifted into the canal. If migrating smolts avoid shallow areas, and it their movements are affected by tne thalweg, one would expect large numbers of migrants to enter the canal when P.D.C. is high.

Appendix Figure B.2 plots the best regressions of P.D.C. on etficiency for 1984 data alone and for combined data from 1984 and 1985. Relative to 1985, the 1984 relationship underestimates etficiency by as much as 20 percent over a range of diversions from about 10 to 60 percent. As the diversions that normally occur during April and May are also in this range, outmigration in 1984 was substantially overestimated in last year's annual report.

Estimation of Outmigration

Daily outmigration was estimated by dividing actual smolt trap captures by the daily trapping efficiency. Daily trapping efficiency was estimated as a moving 3-day average of eftrciency values generated by the logistic relationship. A moving 3-day average efficiency was assigned to the captures of a given day because fish do not move entirely through the canal in a single day, and because the regression of P.D.C. on efficiency was based on an average base period of 3 days in 1985. The 7-day moving average efficiency used in 1984 has become



Appendix Figure B.2. Logistic and linear regressions of percent discharge into canal on efficiency, combined data from 1984 and 1985. Modified 90 percent confidence intervales for linear relationship.

inappropriate because the configuration of exit ports in 1985 apparently permitted migrating smolts to exit more rapidly than was possible previously. In addition, there were a number of very sharp changes in P.D.C. that occurred in 1985 and the latter part of 1984. During these periods of rapid hydrographic change, a shorter base period is more realistic.

Assigning Bounds to OUtmigration Estimates

The computer program with which 1984 and 1985 data was fit to a logistic relationship did not have the capacity to estimate confidence intervals. Modified 90 percent confidence intervals about the next best relationship, the linear regression, were used to place rough bounds on the logistic efficiency estimates. The linear regression on combined 1984 and 1985 data was modified in two respects (see Appendix Figure B.l); estimates were not allowed to exceed 100 percent, nor to be less than zero. The lowest efficiency actually observed was 11.6 percent, and the linear regression gives this value a P.D.C. of 15.4. The linear regression was prevented from going below zero by drawing a straight line between the origin (of the plot of efficiency as a function of P.D.C.) and the point (15.4, 11.61, and using the equation of this line to estimate efficiency when P.D.C. was under 15.4. In a similar manner, the upper and lower bounds of the 90 percent confidence interval about the linear regression were modified to exclude estimates above 100 or less than zero.

Appendix Table A.7. Recaptures of Branded chinook in 1984 efficiency tests at Chandler Canal.

RECAPTURE DAY	CANAL RECAPTURES Release1 4/10/84	Release2 4/12/84	Release3 4/17/84	Release4 4/20/84	Release5 4/27/84	Release6 4/29/84	Release9 4/30/84	Release10 5/11/84	Release11 5/15/84	Release12 5/22/84	TOTAL
1	45	15	9	45	54	17	33	9	13	4	244
2	11	4	6	11	19		9	11	9	1	88
3	3	18	5	6	11	7	2	1	7	1	55
4	0	5	6	3	8	1	3		2	0	31
5	0	2	0	1	2	2	2	3	0	2	18
6	1	1	2	5	5	0		3		0	27
7	0	4	0	6	6	6	3	2	3	0	30
8	0	1	5	6	0	4	9	0	4	0	29
9	0	0	4	6	3	1	3	0	2	0	19
10	1	9	0	3	1	1	3	0	0	0	18
11	0	1	1	5	1	0	1	0	1	1	11
12	0	3	0	0	1	1	6	2	0	0	13
13	0	2	1	4	1	0	2	3	0	0	13
14	0	1	2	0	1	0	1	0	1	0	6
15	0	0	0	0	0	2	0	0	0	0	3
16	0	0	0	0	0	0	1	0	0	0	2
17	0	0	0	0	1	1	0	0	1	0	2
18	0	0	0	0	1	1	1	0	0	0	
19	0	0	0	0	3	3	0	0	0	0	3
20	0	0	2	0	1	1	0	0	0	0	3
21	0	1	1	0	0	0	1	3	0	0	3
22	0	0	0	0	0	0	1	0	0	0	0
23	0	0	0	1	1	1	0	0	0	0	2
24	0	1	0	0	1	1	0	0	0	0	2
25	0	0	0	0	0	1	0	0	0	0	1
26	0	0	0	0	1	1	0	0	0	0	2
27	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	1	0	0	0	0	
31	0	0	0	0	0	0	0	0	0	0	6
32	0	1	0	0	0	0	0	0	0	0	1
33	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0
40	0	0	1	0	0	0	0	0	0	0	1

RECAPTURE DAY	2-MILE RECAPTURES Release1 4/10 84	Release3 4/19/84	Release4 4/20/84	Release5 4/27/84	Release6 4/29/84	Release10 5/11/84	Release11 5/15/84	Release12 5/22/84	TOTAL	3-MILE RECAPTURES Release1 4/10/84	Release4 4/20/84	Release5 4/27/84	TOTAL
1	8	15	29	26	7	6	3	0	94	5	29	25	
2	6	4	10	19	13	16	0	1	69	6	24	26	
3	8	9	3	14	4	5	2	0	45	4	8	17	
4	0	7		8	1	3	1	1	28	1	4	12	
5	2	6	3	1	2	8	0	0	22	1	11	1	
6	2	6	2	9	0	0	0	0	19	1	6	8	
7	0	5	2	3	4	4	0	0	18	0	14	3	
8	1	1	6	1	6	2	0	0	17	2	14	3	
9	1	2	4	7	4	1	0	0	19	0	8	4	
10	4	7	2	1	2	1	0	0	17	0	4	1	
11	0	2	0	1	1	0	0	0	4	1	5	7	
12	0	2	0	1	6	0	0	0	9	0	1	3	
13	0	0	0	0	0	1	0	0	1	0	4	3	
14	0	2	0	4	0	2	0	0	8	0	2	3	
15	0	0	1	0	1	0	0	0	2	0	1	1	
16	0	1	0	3	1	0	0	0	5	0	2	0	
17	0	0	3	2	2	0	0	0	7	0	1	1	
18	0		1	0	1	0	0	0	3	0	0	0	
19	0	6	0	1	0	0	0	0	1	0	0	2	
20	0	1	0	0	2	0	0	0	3	0	1	0	
21	0	0	1	1	0	0	0	0	2	0	0	0	
22	0	0	0	1	1	0	0	0	2	0	1	0	
23	0	0	0	0	2	0	0	0	2	0	2	2	
24	0	0	0	0	0	0	0	0	0	0	0	1	
25	0	1	1	0	0	0	0	0	2	0	0	2	
26	0	0	0	1	0	0	0	0	1	0	0	0	
27	0	0	0	0	0	0	0	0	0	0	0	0	
28	0	0	0	0	0	0	0	0	0	0	0	0	
29	0	0	0	0	0	0	0	0	0	0	2	0	
30	0	1	0	0	0	0	0	0	1	0	0	0	
31	0	0	1	0	0	0	0	0	1	0	0	0	
32	0	0	0	0	0	0	0	0	0	0	0	0	
33	0	0	0	0	0	0	0	0	0	0	0	0	
34	0	1	0	0	0	0	0	0	1	0	0	0	
35	0	0	0	0	0	0	0	0	0	0	1	0	
36	0	0	0	0	0	0	0	0	0	0	0	0	
37	0	0	0	0	0	0	0	0	0	0	0	0	
38	0	0	0	0	0	0	0	0	0	0	0	0	
39	0	0	0	0	0	0	0	0	0	0	0	0	
40	0	0	0	0	0	0	0	0	0	0	0	0	

Appendix Table B.8. Recaptures of bra&d chinook in 1985 efficiency tests at Chandler Canal.

Capture date	2-mile											Day canal											Night canal					Day screens	
1	18	75	46	121	120	81	90	39	119	8	767	20	46	111	83	53	109	71	37	63	24	617	99	105	157	86	46	493	57
2	6	27	61	22	10	6	1	8	0	0	141	4	4	15	1	3	3	3	9	0	2	44	0	7	4	1	3	15	1
3	5	14	9	5	3	0	3	3	3	0	45	1	1	4	0	4	1	2	3	1	0	17	0	0	1	0	1	2	2
4	14	6	4	1	1	2	4	0	0	2	34	1	7	1	0	3	2	2	1	0	2	19	0	1	3	1	0	5	1
5	14	10	1	1	0	1		0	0		27	0	0	1	0	0	0	0		0		1	0	0			1	1	0
6	17	10	1	1	1			0	0		30	0	0	0	1	0	0	0		0		1	0	1				1	0
7	3	1			2			0	0		8	0	4	0		3	0	1		0		8	1					1	0
8	18	4			0			0	0		19	0		0			0			0		0	0					0	0
9	7				0			0	1		12	1		0			0			0		1	0					0	1
10	4	1			0			0	0		5			0			0			2		2	0					0	
11	2	0			0			0	0		2			0			0					1	0					0	
12	1	2			1			0	1		3			1			0					0	1					1	
13	2							0			4						0					0							
14	4							1			5						0					0							
15	2										2						0					0							
16	0										0						0					0							
17	2										2						0					0							
18	0										0						0					0							
19	0										0						0					0							
20	1										1						0					0							
21	0										0						1					1							
22	0										0																		
23	0										0																		
24	0										0																		
25	0										0																		
26	0										0																		
27	0										0																		
28	0										0																		
29	0										0																		
30	1										1																		
31																													
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The "confidence intervals" around daily outmigration estimates were generated by dividing the raw catch by the moving 3-day average of the upper and lower bounds of the linear confidence Interval. Obviously, such "confidence intervals" have no statistical significance. Their approximation to "true" confidence intervals – i.e., those derived from the logistic relationship – may, however, be as close as the linear point estimates of outmigration are to the logistic. Appendix Table B.9 indicates a fairly close agreement between linear and logistic point estimates.

Appendix Table B.9. Linear and logistic point estimates of monthly outmigration of wild spring-chinook, wild fall chinook and wild steelhead in 1985 at Prosser trap.

	Wild Spring Chinook		Wild Fall Chinook		Wild Steelhead	
	Logistic	Linear	Logistic	Linear	Logistic	Linear
March	360	355	0	0	496	475
April	43,049	42,587	2,808	2,458	23,838	23,344
May	33,737	34,515	30,721	31,417	28,282	27,862
June	5,421	5,509	25,124	25,073	2,954	2,962
July	0	0	534	516	19	19
Total	82,567	82,966	59,191	59,464	55,589	54,462

Canal Survival

The mean survival of chinook smolts released in the canal at night was 77.4 percent, whereas the mean survival of smolts released in the morning was 47.5 percent (see Appendix Table B.lO). A t-test indicated that survival of night-released fish was significantly (alpha = .005) greater. It would seem most reasonable to attribute the superior survival of fish released at night to the difficulty diurnal predators would have in seeing them.

Data gathered in 1985 and earlier permit a rough estimation of the mortalities suftered by typical "un-handled" chinook smolts as they pass through Chandler Canal.

Appendix Table B.10. Survival rates of branded chinook smolts confined to a net pen in Chandler Canal and released into the canal during the day-time or after dark in 1984 and 1985.

	Survival of chinook smolts (percent)			
Date of release	Day-release	Night-release	Penned through date of capture of last canal fish	Penned through 48 hours
6/8/85	18.9	—	—	—
5/31/85	64.1	55.4	78.0	98.0
5/26/85	43.1	—	91.4	97.1
5/24/85	50.0	77.2	82.0	96.0
5/20/85	66.7	82.9	46.0	100.0
5/16/85	58.9	80.3	57.5	100.0
5/12/85	67.5	95.3	—	100.0
5/9/85	67.5	—	80.0	90.0
5/2/85	71.3	—	100.0	100.0
4/26/85	49.1	—	87.2	97.9
5/31/84	17.3	—	—	—
5/22/84	29.0	—	—	—
5/15/84	46.0	—	—	—
5/11/84	51.9	—	—	—
5/5/84	40.7	—	—	—
5/3/84	29.3	—	—	—
4/30/84	—	49.0	—	—
4/29/84	33.3	—	—	—
4/27/84	57.2	—	—	—
4/26/84	61.7	—	—	—
4/17/84	38.1	- -	- -	—
4/15/84	53.5	—	—	—
4/10/84	30.8	—	- -	—
- p mean	47.5	73.4	77.8	98.1

The mean survival of smolts confined to net-pens in the canal ("penned fish") until the last canal fish was recaptured, 77.8 percent, vas quite similar to the mean survival of night-released canal fish, and a t-test of the mean survival of these groups in the four releases involving both was not significant. As the penned smolts were intended to serve as controls, in the sense that they might establish the losses attributable to handling stress, one might conclude that night-released sanal fish suffer negligible losses to predators and traumatic incidents. Moreover, it the trans-canal survival of night-released canal fish is equavalent to that of un-handled, "first-time" migrants, one might conclude that smolts can negotiate the canal in relative safety so long as they move at night.

These conclusions are unvarranted for a number of reasons. First, penned fish were probably not valid controls on mortality. They were subjected to stressful 10 to 20 minute mortality inventories on a daily basis, many fish suffered extensive descaling in trying to force their way out of the net-pen, and prolonged confinement per se is stressful to migrating smolts. Second, only 1.9 percent of the penned fish died in the first 48 hours, a period in which 97.9 percent of the night-released canal fish vere recaptured. Thus, at a time when survival of penned fish was almost total, the survival of night-released canal fish had basically already been determined; whatever caused the disappearance of 26.6 percent of the night-smolts could not have been handling mortality. Finally, numerous unquantified observations of dead chinook smolts impinged against the diversion screens vere made in 1984 and 1985. Impingement mortality in 1983 was estimated at 5.7 and 8.5 percent, respectively, for migrating spring and fall chinook smolts. If one assumes that the great majority of "first-time" outmigrants negotiate the canal in tvq days or less, and that the losses they sufter in doing so, less tvo percent for handling mortality, are the same as night-released canal fish, then trans-canal survival for first-time outmigrants vould be about 75 percent. If, as vas estimated in 1983, impingement mortalities amount to about 7 percent, losses to canal-dwelling predators must be on the order of 18 percent.

Appendix Table B.ll. Legend for Daily passage headings used in
Appendix B tables B.12 - B.71

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WSCHK = Wild Spring Chinook

WFCHK = Wild fall chinook

HSCHK = Hatchery spring chinook, all releases.

HFCHK = Eatchery fall chinook, branded fish only.

HFCHK2 = Hatchery fall chinook, branded and unbranded fish.

WSTH = Wild steelhead

HSTH = Hatchery steelhead

COHO = Hatchery coho

RATL = Hatchery spring chmook released in Rattlesnake creek.

NOV84 = Eatchery spring chmook released November, 1984, in upper Yakima. Branded fish only.

NOV842 = Hatchery spring chmook released November, 1984, in upper Yakima. Branded and unbranded fish.

SEP84 = Eatchery spring chinook released September, 1984, in upper Yakima. Branded fish only.

SEP842 = Hatchery spring chinook released September, 1984, in upper Yakima. Branded and unbranded fish.

TRUCK = Hatchery spring chmook smolts trucked to upper Yakima in april and released immediately. Branded fish only.

TRUCK2 = Hatchery spring chinook smolts trucked to upper Yakima in April and released iediately. Branded and unbranded fish.

POND = Hatchery spring chinook smolts allowed acclimation in pond on Yakima or Naches rier before volitional release in April. Branded fish only.

POND2 = Hatchery spring chinook smolts allowed acclimation in pond on Yakima or Naches river before volitional release in April Branded and unbranded fish.

JUN85 = Hatchery spring chinook fingerlings released June, 1985, in upper Yakima. Branded fish only.

JUN852 = Hatchery spring chinook fingerlings released June, 1985, in upper Yakima. Branded and unbranded fish.

JUN84 = Hatchery spring chinook fingerlings released June, 1984, in upper Yakima. Branded fish only.

SCHCK= Small hatchery chinook.

Appendix Table B.12. Outmigration for March, 1985.

DAY	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
11	7	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	6	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	3	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	11	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	4	0	4	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	8	0	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	10	0	0	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	30	0	6	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	7	0	0	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	16	0	5	0	0	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	34	0	2	0	0	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	60	0	16	0	0	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	30	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	60	0	4	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	40	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	21	0	2	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	7	0	1	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	10	0	3	0	0	39	0	0	0	0	0	1	3	0	0	0	0	0	0	0
TOT	360	0	50	0	0	496	0	0	0	0	0	1	3	0	0	0	0	0	0	0

Appendix Table B.13. Outmigration for April, 1985.

DAY	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RNTL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
1	12	0	4	0	0	30	0	0	0	1	4	0	0	0	0	0	0	0	0	0
2	20	0	8	0	0	44	2	0	0	0	0	2	8	0	0	0	0	0	0	0
3	83	0	13	0	0	189	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	220	0	113	0	0	371	3	0	0	11	113	0	0	0	0	0	0	0	0	0
5	420	0	128	0	0	502	21	0	0	4	41	8	86	0	0	0	0	0	0	0
6	576	0	243	0	0	629	5	0	0	10	71	24	171	0	0	0	0	0	0	0
7	623	0	180	0	0	443	0	0	0	13	61	26	118	0	0	0	0	0	0	0
8	502	13	100	0	0	347	4	0	0	4	25	13	75	0	0	0	0	0	0	0
9	569	15	142	0	0	496	4	0	0	4	46	8	96	0	0	0	0	0	0	0
10	2697	67	370	0	0	795	24	0	0	20	157	28	213	0	0	0	0	0	0	0
11	1203	30	203	0	0	213	15	0	0	5	104	5	99	0	0	0	0	0	0	0
12	2107	52	450	0	0	840	440	0	0	6	55	44	383	0	0	0	0	0	0	0
13	2107	52	450	0	0	840	440	0	0	6	55	44	383	0	0	0	0	0	0	0
14	2333	48	857	0	0	1095	905	0	48	0	0	143	810	0	0	0	0	0	0	0
15	2000	259	370	0	0	1259	815	0	0	0	0	0	0	37	370	0	0	0	0	0
16	3550	475	475	0	0	1525	1300	0	50	0	0	50	425	0	0	0	0	0	0	0
17	3418	473	655	0	0	1273	1436	0	18	18	218	36	418	0	0	0	0	0	0	0
18	4041	548	493	0	0	685	1466	0	14	0	0	68	479	0	0	0	0	0	0	0
19	583	78	117	0	0	1379	1272	0	10	0	0	10	107	0	0	0	0	0	0	0
20	214	30	113	0	0	1256	1292	0	0	0	0	0	0	0	0	0	0	0	0	0
21	120	14	88	0	0	1339	1272	0	4	7	42	7	42	0	0	0	0	0	0	0
22	166	7	101	0	0	1058	787	0	4	2	20	4	40	2	22	2	13	0	0	0
23	290	13	172	0	0	959	1017	0	2	2	19	9	116	2	22	2	14	0	0	0
24	1053	43	409	0	0	758	817	0	21	4	57	11	163	0	0	15	166	0	0	0
25	998	42	440	0	0	734	709	0	15	8	121	8	115	2	37	13	151	0	0	0
26	1306	55	375	0	0	700	739	0	19	6	115	7	129	0	0	8	112	0	0	0
27	2628	109	1185	0	0	977	1084	0	48	14	191	33	434	16	236	28	277	0	0	0
28	4656	194	2834	0	0	1012	1263	0	242	27	355	61	760	33	458	107	1019	0	0	0
29	2245	94	1518	0	0	724	747	0	164	22	283	22	267	15	200	65	602	0	0	0
30	2309	97	1813	0	0	1366	1232	0	248	1	20	31	467	18	307	66	771	0	0	0
TOT	43049	2808	14419	0	0	23838	19111	0	907	195	2173	702	6404	125	1652	306	3125	0	0	0

Appendix Table B.14. **Outmigration** for May, 1985.

DAY	USCHK ESTD	UFCHK ESTD	LSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	USTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
1	1400	337	1461	0	0	1061	734	0	242	14	161	18	195	30	362	61	501	0	0	
2	2100	505	1225	0	0	927	613	0	249	11	119	19	201	22	254	51	402	0	0	8
3	2435	586	1323	0	0	967	573	0	297	5	55	14	158	32	411	47	409	0	0	0
4	2531	608	1712	0	0	1414	759	0	318	7	110	15	225	34	583	41	476	0	0	0
5	1070	450	1901	0	0	1625	1026	0	329	17	229	20	248	37	524	68	651	0	0	
6	1495	360	1474	0	0	1346	555	0	268	9	128	14	191	36	545	33	343	0	0	8
7	920	221	1018	0	0	1042	370	0	224	1	13	14	161	23	285	39	335	0	0	
8	807	714	892	0	0	1019	345	0	209	5	51	24	214	20	197	33	222	0	0	8
9	647	573	681	0	0	864	375	0	175	0	0	8	104	12	162	25	240	0	0	
10	1116	988	754	0	0	069	272	0	176	2	27	9	113	21	204	17	154	0	0	8
11	733	649	762	0	0	1067	365	0	166	4	51	9	107	20	255	21	182	0	0	
12	681	603	1216	0	0	911	293	0	188	6	110	9	137	28	504	22	277	0	0	8
13	690	618	519	0	0	935	262	0	145	2	29	2	28	10	135	19	183	0	0	0
14	919	814	618	0	0	800	103	0	01	0	0	0		5	194	14	343	0	0	0
15	511	663	282	0	0	697	137	0	52	1	15	0	8	9	127	9	87	0	0	0
16	590	766	227	0	0	729	166	0	52	0	0	1			26	8	125		0	0
17	1560	2024	508	0	0	969	242	0	119	2	23	7	a:	1:	166	18	137	8	0	0
18	1717	2229	611	0	0	1549	407	0	192		58	2	28	15	204	14	129	0	0	0
19	1648	2139	2019	0	0	1997	1154	0	578	3	88	7	82	60	831	46	440	0	0	0
20	950	1233	2209	0	0	1551	1222	0	541	2	15	23	195	104	988	73	469		0	
21	1182	1531	1742	0	0	1537	1236	0	313	6	86	18	242	39	607	47	494	8	0	8
22	947	1586	1106	0	0	1438	904	0	193	7	82	15	157	33	401	33	270	0	0	0
23	906	1651	666	0	0	803	473	0	92	5	51	3	33	34	365	17	125	0	0	0
24	1106	1854	448	0	0	467	392	0	116	0		2	17	21	226	12	89		0	0
25	319	532	197	0	0	253	245	0	24	0	8	0	0	2	24	18	149	8	0	0
26	601	1007	321	0	0	334	232	0	41	0	0	0	0	4	91	13	189		0	
27	049	1424	304	0	0	275	110	0	112	2	23	0		10	128	14	122	8	0	8
28	645	1002	229	0	0	312	66	0	28	0			8	14	142	9	59	0	0	
29	575	962	171	0	0	264	56	47	25	0	8	8	0	12	124	3	21	0	0	8
30	420	704	181	0	0	122	54		17	0	0	3	26	8	87	0	0	0	0	0
31	779	1308	190	0	0	138	60	a	21	1	27	0	0	0	0	4	61	0	0	0
TOT	33737	30721	27133	0	0	28282	13961	56	5583	121	1551	256	2950	711	9232	829	7604	0	0	0

Appendix Table B.15. Outmigration for June, 1985.

DAY	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
1	502	1506	137	0	0	135	64	1601	20	0	0	0	0	2	55	0	0	0	0	0
2	549	1645	67	0	0	203	94	7343	18	0	0	0	0	0	0	3	38	0	0	0
3	417	1252	43	0	0	176	89	9069	10	2	12	0	0	2	13	1	4	0	0	0
4	985	2956	32	0	0	301	62	15923	7	0	0	0	0	2	14	2	9	0	0	0
5	344	1033	62	0	0	276	52	10307	20	0	0	0	0	0	0	0	0	0	0	0
6	389	1170	52	0	0	413	33	13263	20	0	0	0	0	0	0	3	33	0	0	0
7	405	1212	56	0	0	355	48	12119	20	0	0	0	0	0	0	2	36	0	0	0
8	125	848	43	0	0	102	58	6704	9	0	0	2	15	2	15	0	0	0	0	0
9	58	386	24	0	0	48	17	2180	7	0	0	2	14	0	0	0	0	0	0	0
10	108	730	20	0	0	137	25	2926	5	0	0	0	0	0	0	0	0	0	0	0
11	245	1668	29	0	0	264	38	3721	10	0	0	0	0	5	19	0	0	0	0	0
12	510	3436	6	0	0	151	42	2623	3	0	0	0	0	0	0	0	0	0	0	0
13	393	2658	7	0	0	54	26	987	0	0	0	0	0	2	6	0	0	0	0	0
14	222	1503	25	0	0	46	6	430	3	0	0	0	0	0	0	0	0	1	1	1
15	50	928	82	0	0	50	8	402	0	0	0	0	0	0	0	0	0	0	0	0
16	23	407	69	0	0	23	3	205	0	0	0	0	0	0	0	0	0	0	0	0
17	28	511	65	0	0	33	3	122	1	0	0	0	0	0	0	0	0	0	0	0
18	29	527	10	3	53	67	13	240	3	0	0	0	0	0	0	0	0	0	0	53
19	6	105	15	2	12	14	4	40	0	0	0	0	0	0	0	0	0	0	0	12
20	2	48	8	2	18	20	2	23	0	0	0	0	0	0	0	0	0	0	0	18
21	4	71	6	18	225	4	1	28	0	0	0	0	0	0	0	0	0	0	0	225
22	8	157	6	43	441	8	0	47	1	0	0	0	0	0	0	0	0	0	0	441
23	2	48	7	26	468	6	1	28	0	0	0	0	0	0	0	0	0	0	0	468
24	2	31	26	34	564	14	4	20	0	0	0	0	0	0	0	0	0	1	22	586
25	3	53	20	91	819	17	3	37	1	0	0	0	0	0	0	0	0	0	0	819
26	1	22	17	83	772	8	2	24	2	0	0	0	0	0	0	0	0	1	13	784
27	2	45	41	71	692	9	0	46	0	0	0	0	0	0	0	0	0	2	26	718
28	4	79	15	156	1360	13	1	21	1	0	0	0	0	0	0	0	0	3	35	1394
29	3	60	4	62	804	4	1	21	2	0	0	0	0	0	0	0	0	6	105	909
30	2	29	0	126	1385	3	0	14	0	0	0	0	0	0	0	0	0	2	29	1414
TOT	5421	25124	994	717	7613	2954	700	90514	163	2	12	4	29	15	122	11	120	16	231	7842

Appendix Table B.16. Outmigration for July, 1985.

DAY	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATI ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
1	0	48	2	115	1475	5	0	21	1	0	0	0	0	0	0	0	0	10	156	1631
2	0	95	0	220	2136	2	1	20	0	0	0	0	0	0	0	0	0	22	277	2413
3	0	77	4	182	1347	5	0	20	0	0	0	0	0	0	0	0	0	34	322	1669
4	0	43	0	103	1337	0	0	4	0	0	0	0	0	0	0	0	0	8	140	1477
5	0	26	0	127	2592	4	0	4	0	0	0	0	0	0	0	0	0	9	247	2839
6	0	14	0	71	1694	0	3	0	0	0	0	0	0	0	0	0	0	8	255	1949
7	0	21	0	57	1214	0	0	0	0	0	0	0	0	0	0	0	0	6	170	1385
8	0	35	0	49	755	0	0	0	0	0	0	0	0	0	0	0	0	15	288	1043
9	0	8	1	23	404	1	0	0	1	0	0	0	0	0	0	0	0	13	282	685
10	0	3	0	26	359	0	0	0	0	0	0	0	0	0	0	0	0	6	111	470
11	0	7	0	49	307	0	0	0	0	0	0	0	0	0	0	0	0	5	42	349
12	0	9	0	19	168	0	0	0	0	0	0	0	0	0	0	0	0	10	119	287
13	0	13	1	6	112	0	0	0	0	0	0	0	0	0	0	0	0	6	144	256
14	0	37	0	5	147	0	0	3	0	0	0	0	0	0	0	0	0	5	192	340
15	0	21	0	6	83	0	0	1	0	0	0	0	0	0	0	0	0	26	446	529
16	0	9	0	17	111	0	0	0	0	0	0	0	0	0	0	0	0	15	125	236
17	0	10	0	8	98	0	0	0	0	0	0	0	0	0	0	0	0	2	30	128
18	0	3	0	3	41	0	0	0	0	0	0	0	0	0	0	0	0	3	54	95
19	0	4	0	7	75	1	0	0	0	0	0	0	0	0	0	0	0	1	13	88
20	0	6	0	0	22	1	0	0	0	0	0	0	0	0	0	0	0	0	21	44
21	0	8	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0	20	39
22	0	7	0	1	8	0	0	0	0	0	0	0	0	0	0	0	0	5	55	63
23	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	43	43
24	0	5	0	1	18	0	0	0	0	0	0	0	0	0	0	0	0	1	21	38
25	0	6	0	1	7	0	0	0	0	0	0	0	0	0	0	0	0	2	17	24
26	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	35	35
27	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	63	63
28	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	50	50
29	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	23	23
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	19	19
31	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	21	21
TOT	0	538	8	1096	14531	19	4	73	2	0	0	0	0	0	0	0	0	231	3801	18331

Appendix Table B.17. Linear estimate of outmigration for March, 1985.

DAY	USCHK ESTD	UFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
11	6	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	6	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	3	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	9	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	3	0	3	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	6	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	9	0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	28	0	5	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	7	0	0	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	16	0	5	0	0	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	33	0	2	0	0	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	56	0	15	0	0	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	30	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	62	0	4	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	43	0	0	0	0	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	23	0	2	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	8	0	2	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	11	0	3	0	0	43	0	0	0	0	0	2	3	0	0	0	0	0	0	0
TOT	355	0	48	0	0	475	0	0	0	0	0	2	3	0	0	0	0	0	0	0

Appendix Table B.18. Linear estimate of outmigration for April, 1985.

DAY	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	[illegible]
1	13	0	5	0	0	34	0	0	0	2	5	0	0	0	0	0	0	0	0	0
2	22	0	9	0	0	48	2	0	0	0	0	2	9	0	0	0	0	0	0	0
3	86	0	14	0	0	196	0	0	0	0	0	0	0	2	8	2	6	0	0	0
4	206	0	106	0	0	348	3	0	0	10	106	0	0	0	0	0	0	0	0	0
5	340	0	103	0	0	407	17	0	0	3	33	7	70	0	0	[illegible]	0	0	0	0
6	442	0	186	0	0	482	4	0	0	7	55	18	131	0	0	0	0	0	0	0
7	488	0	141	0	0	347	0	0	0	10	48	21	93	0	0	0	0	0	0	0
8	397	10	79	0	0	275	3	0	0	3	20	10	60	0	0	0	0	0	0	0
9	464	13	116	0	0	404	3	0	0	3	38	6	78	0	0	0	0	0	0	0
10	2188	54	300	0	0	645	19	0	0	16	128	22	173	0	0	0	0	0	0	0
11	972	24	164	0	0	172	12	0	0	4	84	4	80	0	0	0	0	0	0	0
12	1692	42	361	0	0	674	353	0	10	5	44	36	308	0	0	0	0	0	0	0
13	2164	54	462	0	0	863	452	0	12	6	56	45	393	0	0	0	0	0	0	0
14	6125	125	2250	0	0	2875	2375	0	125	0	0	375	2125	0	0	0	0	0	0	0
15	2160	280	400	0	0	1360	880	0	0	0	0	0	0	40	400	0	0	0	0	0
16	2784	373	373	0	0	1196	1020	0	39	0	0	39	333	0	0	0	0	0	0	0
17	2380	329	456	0	0	886	1000	0	13	13	152	25	291	0	0	0	0	0	0	0
18	2892	392	353	0	0	490	1049	0	10	0	0	49	343	0	0	0	0	0	0	0
19	420	56	84	0	0	993	916	0	7	0	0	7	77	0	0	0	0	0	0	0
20	164	23	87	0	0	963	991	0	0	0	0	0	0	0	0	0	0	0	0	0
21	104	12	77	0	0	1163	1104	0	3	6	37	6	37	0	0	0	0	0	0	0
22	164	7	100	0	0	1049	780	0	4	2	20	4	40	2	22	2	13	0	0	0
23	308	13	183	0	0	1022	1083	0	2	2	20	10	123	2	23	2	15	0	0	0
24	1082	45	420	0	0	778	839	0	22	4	59	11	167	0	0	15	171	0	0	0
25	984	41	433	0	0	724	699	0	15	8	119	8	114	2	37	13	148	0	0	0
26	1238	52	355	0	0	664	701	0	18	6	109	7	122	0	0	8	106	0	0	0
27	2568	107	1158	0	0	955	1059	0	47	14	186	32	424	16	230	27	270	0	0	0
28	4753	198	2893	0	0	1033	1289	0	247	28	362	62	776	33	467	109	1040	0	0	0
29	2423	101	1638	0	0	781	806	0	177	24	306	24	289	16	216	70	650	0	0	0
30	2564	107	2013	0	0	1517	1367	0	275	1	23	34	518	20	340	73	856	0	0	0
TOT	42587	2458	15319	0	0	23344	18826	0	1026	177	2010	864	7174	133	1743	321	3275	0	0	0

Appendix Table B.19. Linear estimate of outmigration for Way, 1985.

DAY	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD 0	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NW042 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
	1563	376	1631	0	0	1105	020	0	270	16	100	20	210			60	560	0	0	0
2	2184	526	1274	0	0	964	637	0	259	11	124	20	209	3:	404 264	53	418	0	0	0
3	2438	507	1330	0	0	968	573	0	297	5	55	14	158	32	412	47		0	0	0
4	2534	[illegible]	1714		0	1416	760	0	319	7	110	15	225	40	504	41	409 477	0	0	0
5	1985	470	2104	0	0	1726	1090	0	350	18	243	21	264	39	600 557	73	691	0	0	0
6	1646	396	1624	0	0	1482	611	0	295	10	140	15	211			37	370	0	0	0
7	940	220	1049	0	0	1074	382	0	231	1	13	15	166	23		40	345	0	0	0
8	794	702	070	0	0	1002	339	0	205	5	50	24	211	19	293 193	32	210	0	0	0
9	615	545	640			022	357	0	166	0	0	8	99	20	154	24	220	0	0	0
10	1066	944	720	8	0	830	260	0	160	2	26	9	108	19	242 271	16	147	0	0	0
11	696	616	723		0	1013	346	0	150	4	48	9	102			20	173	0	0	0
12	642	569	1146	0	0	059	276	0	170	6	103	0	129	26	475	21		0	0	0
13	654	579	406	0	0	076	246	0	135	2	27	2	26	9	126	18	261 172	0	0	0
14	061	762	579	0	0	749	172	0	76	0	0	0	0	5	102	13	321	0	0	0
15	479	622	264	0	0	654	129	0	49	1	14	0	0	8	120	0	81	0	0	0
16	561	730	216			694	150	0	49	0	0	1	23	1	25	7	119			0
17	1513	1962	493	0	8	939	234	0	116	2	22	6	62	15	161	18	132	0	8	0
18	1747	2267	622			1576	414	0	196	5	59	2	29	15	207	14	131	0	0	0
19	1719	2231	2105	8	11	2003	1204	0	602	7	91	7	86	62	867	48	450	0	0	0
20	1011	1312	2349	0	0	1650	1299	0	576	2	16	25	208	111	1051	77	490	0	0	0
21	1222	1504	1002	0	0	1590	1279	0	323	6	89	18	251	40	620	48		0		0
22	990	1671	1165	0	0	1515	1037	0	204	8	87	15	165	35	423	35	511 205	0	8	0
23	1061	1775	716	0	0	064	508		99	6	55	4	35	37	392	10	134	8	0	0
24	1104	1985	400	8	0	500	420	8	125	0	0	2	19	22	242				0	0
25	327	546	202		0	260	252		25	0	0	0	0	2	25	13	95	0	0	0
26	600	1004	320	8	0	333	232	8	41	0	0	0	0	4	91	18	15[illegible]	0	0	0
27	062	1444	390	0	0	279	111	0	113	2	23	0	0	10	130	13	124	0	0	0
28	685	1149	243	0	0	331	70	0	30			0		15	151	9	62	0		0
29	630	1055	100		0	290	62	52	28	8	8	0	8	13	136	3	23	0	8	0
30	459	769	190	0	0	133	59	3	18	0	0	3	20	0	95	0	0	0	0	0
31	031	1394	203		0	148	64	6	23		29	0	0	0	0	4	65		0	0
.OT	34515	31417	27062	8	0	20005	14401	61	5724	12:	1604	263	3032	731	9501	851	7857	8	0	0

Appendix Table B.20. Linear estimate of outmigration for June, 1985.

DAY	USCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
1	524	1570	143	0	0	140	67	1669	21	0	0	0	0	2	58	0	0	0	0	0
2	566	1698	69	0	0	209	97	7580	18	0	0	0	0	0	0	3	39	0	0	0
3	430	1289	44	0	0	181	92	9341	10	2	13	0	0	2	14	1	5	0	0	0
4	023	3070	33	0	0	313	64	16539	7	0	0	0	0	2	14	2	9	0	0	0
5	364	1091	65	0	0	291	55	10881	21	0	0	0	0	0	0	0	0	0	0	0
6	1418	1255	56	0	0	443	35	14225	21	0	0	0	0	0	0	4	35	0	0	0
7	440	1317	61	0	0	386	52	13169	22	0	0	0	0	0	0	3	39	0	0	0
8	130	886	44	0	0	106	60	7002	10	0	0	2	16	0	0	0	0	0	0	0
9	56	377	23	0	0	47	16	2129	7	0	0	2	14	2	16	0	0	0	0	0
10	84	571	15	0	0	107	19	2287	4	0	0	0	0	0	0	0	0	0	0	0
11	193	1314	23	0	0	208	30	2932	8	0	0	0	0	0	0	0	0	0	0	0
12	466	3138	5	0	0	138	38	2396	3	0	0	0	0	4	15	0	0	0	0	0
13	405	2745	8	0	0	56	27	1019	0	0	0	0	0	0	0	0	0	0	0	0
14	240	1629	27	0	0	50	6	466	3	0	0	0	0	2	6	0	0	2	2	2
15	54	1001	88	0	0	54	9	433	0	0	0	0	0	0	0	0	0	0	0	0
16	23	412	70	0	0	23	3	208	0	0	0	0	0	0	0	0	0	0	0	0
17	27	497	63	0	0	32	3	119	1	0	0	0	0	0	0	0	0	0	0	0
18	27	498	9	3	50	63	12	227	3	0	0	0	0	0	0	0	0	0	0	50
19	6	100	14	2	11	13	4	38	0	0	0	0	0	0	0	0	0	0	0	11
20	2	46	8	2	17	19	2	22	0	0	0	0	0	0	0	0	0	0	0	17
21	4	68	6	17	215	4	1	27	0	0	0	0	0	0	0	0	0	0	0	215
22	8	150	6	41	420	8	0	45	1	0	0	0	0	0	0	0	0	0	0	420
23	2	46	7	25	446	6	1	27	0	0	0	0	0	0	0	0	0	0	0	446
24	2	30	25	32	539	13	4	19	0	0	0	0	0	0	0	0	0	1	21	560
25	3	51	19	87	783	16	3	35	1	0	0	0	0	0	0	0	0	0	0	783
26	1	21	16	79	737	8	2	23	2	0	0	0	0	0	0	0	0	1	12	749
27	2	43	39	68	660	9	0	44	0	0	0	0	0	0	0	0	0	2	25	685
28	4	75	14	149	1297	12	1	20	1	0	0	0	0	0	0	0	0	3	33	1330
29	3	57	4	59	765	4	1	20	2	0	0	0	0	0	0	0	0	6	100	865
30	2	28	0	120	1317	3	0	13	0	0	0	0	0	0	0	0	0	2	28	1345
TOT	5509	25073	1004	684	7257	2962	704	92955	165	2	13	4	30	14	123	13	127	17	221	7478

Appendix Table B.21. Linear estimate of outmigration for July, 1985.

M Y	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	IW04 ESTD	NW042 ESTD	SEP04 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
	0	45	2	110	1401	5	0	20	1	0	0	0	0	0	0	0	0	9	140	1549
2	0	09	0	200	2016	2	1	19	0	0	0	0	0	0		0	0	21	261	2277
3	0	72	4	172	1272	5	0	19	0		0			0	8	0		32	305	1577
4	0	41	0	ɔo	1269	0	0	4	0	8	0	8	8	0		0	8	8	133	1402
5	0	25	0	121	2478	4	0	4	0	0	0	0	0	0	8	0	0	9	236	2714
6	0	13		60	1621	0	3	0	0	0	0	0	0	0	0	0	0	8	244	1065
7	0	20	8	55	1162	0	0	0	0	0	0	0	0	0	0	0	0	6	163	1325
8	0	34	0	47	723	0	0	0	0		0	0	0		0	0	0	14	276	999
9	0	8	1	22	307	1	0	0	1	8	0	0	0	8	0	0	0	12	270	657
10	0	3	0	25	345	0	0	0	0		0	0	0	0	0	0		6	107	452
11	0	7	0	47	296	0	0	0	0	8	0		0	0		0	8	5	-40	336
12	0	9	0	18	162	0	0	0	0		0	8			8		0	10	115	277
13	0	13	1	6	100	0	0	0	0	8	0	0	8	8		8	0	6	139	247
14	0	36	0	5	142	0	0	3	0	0	0	0		0	8	0	0	5	105	327
15	0	20	0	6	80	0	0	1	0	0	0	0	8	0	0	0	0	25	420	500
16		9	0	16	106	0	0	0	0	0		0	0	0	0	0	0	14	120	226
17	8	10	0	8	94	0	0	0	0		8		0	0	0	0	0	2	29	123
18		3	0	3	40	0	0	0	0	8		8	0	0	0		0	3	52	
19	8	4	0	7	72	1	0	0	0	0	8	0	0		0	8	0	1	13	85
20		6		0	0	1			0	0	0	0	0	8	0	0	0	0	0	42
21	8	8	8	0	0	0	8	8	0	0	0	0	0	0		0		0	0	38
22		7	0	1	8	0	0	0	0	0	0	0	0	0	8	0	8	5	41	61
23	8	5	0	1	0	0	0		0	0		0	0	0	0	0	0	7	20	41
24	0		0	1	17	0		8	0	0	8		0	0		0		1		37
25	0	a	0	0	7	0	8		0	0	0	8	0		8	0	8	2	16	23
26	0	2	0	0	0	0	0	8	0	0	0	0	0	8	0	0	0	2	34	
27		7	0		0	0	0	0	0	0	0	0	0		0	0	0	3	48	a:
20	8	2	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	1	22	48
29		5	0	0	0		0		0	0	0		0	0	0	0	0	3		22
30	8	0	0		0	8	0	8	0	0	0	8		0	0	0	0	1	18	18
31	0	2	0	0	0	0	0	0	0		0		8	0		0	0	2	20	20
TOT	0	516	0	1045	13006	19	4	70	2	8	0	8	0	0	8	0	0	223	3597	17483

Appendix Table B.22. Lower Bound of 90 percentc onfi dece inerval about linear estimate of outmigrat n for March, 1985

DAY	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
11	4	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	2	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	7	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	2	0	2	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	5	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	7	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	22	0	4	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	6	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	13	0	4	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	27	0	2	0	0	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	46	0	12	0	0	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	25	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	53	0	4	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	38	0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	20	0	2	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	7	0	1	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	10	0	3	0	0	39	0	0	0	0	0	1	3	0	0	0	0	0	0	0
TOT	294	0	40	0	0	394	0	0	0	0	0	1	3	0	0	0	0	0	0	0

Appendix Table B.23. Low erBou ndof 90 percent conf ide interval about linear estimate of outmigration fr April, 1985.

DAY	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
1	12	0	4	0	0	30	0	0	0	1	4	0	0	0	0	0	0	0	0	0
2	20	0	8	0	0	43	2	0	0	0	0	2	8	0	0	0	0	0	0	0
3	74	0	12	0	0	169	0	0	0	0	0	0	0	2	7	2	5	0	0	0
4	164	0	84	0	0	277	2	0	0	8	84	0	0	0	0	0	0	0	0	0
5	246	0	75	0	0	294	12	0	0	2	24	5	51	0	0	0	0	0	0	0
6	306	0	129	0	0	334	3	0	0	5	38	13	91	0	0	0	0	0	0	0
7	348	0	100	0	0	248	0	0	0	7	34	15	66	0	0	0	0	0	0	0
8	288	7	58	0	0	199	2	0	0	2	14	7	43	0	0	0	0	0	0	0
9	344	9	86	0	0	300	2	0	0	2	28	5	58	0	0	0	0	0	0	0
10	1612	40	221	0	0	475	14	0	0	12	94	16	127	0	0	0	0	0	0	0
11	643	16	108	0	0	114	8	0	0	3	56	3	53	0	0	0	0	0	0	0
12	744	18	159	0	0	297	155	0	4	2	19	16	135	0	0	0	0	0	0	0
13	335	8	72	0	0	134	70	0	2	1	9	7	61	0	0	0	0	0	0	0
14	217	4	80	0	0	10[illegible]						[illegible]	75	0	[illegible]					
[illegible]	231	30	43	0	0	145	94	0	0	0	0	0	0	4	43	0	0	0	0	0
16	580	78	78	0	0	249	212	0	8	0	0	8	69	0	0	0	0	0	0	0
17	732	101	140	0	0	272	307	0	4	4	47	8	89	0	0	0	0	0	0	0
18	1097	149	134	0	0	186	398	0	4	0	0	19	130	0	0	0	0	0	0	0
19	203	27	41	0	0	480	443	0	3	0	0	3	37	0	0	0	0	0	0	0
20	102	14	54	0	0	598	615	0	0	0	0	0	0	0	0	0	0	0	0	0
21	78	9	57	0	0	869	826	0	2	5	28	5	28	0	0	0	0	0	0	0
22	137	6	83	0	0	878	653	0	4	2	17	4	33	2	19	2	11	0	0	0
23	274	12	163	0	0	907	962	0	1	1	18	9	109	1	21	1	13	0	0	0
24	1019	42	395	0	0	733	791	0	20	4	55	11	157	0	0	14	161	0	0	0
25	957	40	421	0	0	704	680	0	15	7	116	7	111	2	36	13	144	0	0	0
26	1237	52	355	0	0	663	700	0	18	6	109	7	122	0	0	8	106	0	0	0
27	2489	104	1123	0	0	926	1026	0	46	13	181	31	411	15	223	26	262	0	0	0
28	4479	187	2727	0	0	974	1215	0	233	26	342	59	731	31	440	103	980	0	0	0
29	2205	92	1490	0	0	711	734	0	161	22	278	22	263	14	197	64	591	0	0	0
30	2339	98	1836	0	0	1384	1247	0	251	1	21	31	473	18	311	67	781	0	0	0
TOT	23512	1143	10336	0	0	13695	11257	0	780	136	1616	326	3531	89	1297	300	3054	0	0	0

Appendix Table B.24. Lower Bound of 90 percent confidence interval about linear estimate of outmigration for May, 1985.

DAY	USCHK ESTD	UFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	USTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
1	1422	343	1484	0	0	1078	746	0	246	15	164	19	198	30	368	62	509	0	0	0
2	2068	498	1206	0	0	912	603	0	245	11	117	19	198	21	250	50	396	0	0	0
3	2318	558	1265	0	0	920	545	0	282	4	52	13	150	31	391	45	389	0	0	0
4	2410	579	1630	0	0	1347	723	0	303	7	104	14	214	33	555	39	453	0	0	0
5	1824	439	1933	0	0	1585	1001	0	321	17	223	19	242	36	512	67	635	0	0	0
6	1499	361	1478	0	0	1349	556	0	269	9	128	14	192	36	546	33	344	0	0	0
7	897	216	992	0	0	1015	361	0	218	1	13	14	157	22	277	38	326	0	0	0
8	772	603	854	0	0	975	330	0	200	5	49	23	205	19	188	31	212	0	0	0
9	615	545	648	0	0	822	357	0	166	0	0	8	99	11	154	24	228	0	0	0
10	1066	944	720	0	0	830	260	0	168	2	26	9	108	20	271	16	147	0	0	0
11	696	616	723	0	0	1013	346	0	158	4	48	9	102	19	242	20	173	0	0	0
12	640	567	1143	0	0	856	275	0	177	6	103	8	129	26	474	21	260	0	0	0
13	652	577	485	0	0	873	245	0	135	2	27	2	26	9	126	18	171	0	0	0
14	858	760	577	0	0	747	171	0	76	0	0	0	0	5	181	13	320	0	0	0
15	477	619	263	0	0	651	128	0	49	1	14	0	0	8	119	8	81	0	0	0
16	548	712	211	0	0	677	154	0	48	0	0	1	22	1	24	7	116	0	0	0
17	1440	1868	469	0	0	894	223	0	110	2	21	6	59	14	153	17	126	0	0	0
18	1623	2106	577	0	0	1465	385	0	182	4	55	2	27	14	192	13	122	0	0	0
19	1563	2029	1914	0	0	1894	1094	0	548	6	83	6	78	57	788	44	417	0	0	0
20	891	1157	2071	0	0	1455	1146	0	508	2	14	22	183	98	927	68	439	0	0	0
21	1056	1368	1557	0	0	1373	1105	0	279	5	77	16	216	35	543	42	442	0	0	0
22	872	1461	1018	0	0	1324	906	0	178	7	76	13	145	30	370	30	249	0	0	0
23	935	1565	631	0	0	761	448	0	88	5	49	3	31	32	346	16	119	0	0	0
24	1043	1748	422	0	0	440	370	0	110	0	0	2	16	20	213	11	83	0	0	0
25	282	470	174	0	0	224	217	0	21	0	0	0	0	2	21	16	132	0	0	0
26	508	851	272	0	0	283	196	0	35	0	0	0	0	4	77	11	160	0	0	0
27	737	1235	333	0	0	238	95	0	97	2	20	0	0	9	111	13	106	0	0	0
28	601	1007	213	0	0	290	61	0	26	0	0	0	0	13	132	8	54	0	0	0
29	567	949	169	0	0	261	55	47	25	0	0	0	0	12	122	3	20	0	0	0
30	417	698	180	0	0	121	54	3	17	0	0	3	25	8	87	0	0	0	0	0
31	756	1269	185	0	0	134	58	6	21	1	26	0	0	0	0	3	59	0	0	0
TOT	32053	28798	25797	0	0	26807	13214	56	5306	118	1489	245	2822	675	8760	707	7288	0	0	0

Appendix Table B.25. Lower Bound of 90 percent confidence interval about linear estimate of outmigration for June, 1985.

DAY	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
1	475	1425	130	0	0	127	61	1515	19	0	0	0	0	2	52	0	0	0	0	0
2	514	1540	63	0	0	190	88	6873	17	0	0	0	0	0	0	3	36	0	0	0
3	390	1169	40	0	0	164	84	8472	9	2	11	0	0	2	13	1	4	0	0	0
4	928	2783	30	0	0	283	58	14994	6	0	0	0	0	2	13	2	8	0	0	0
5	331	992	60	0	0	265	50	9897	19	0	0	0	0	0	0	0	0	0	0	0
6	380	1144	51	0	0	403	32	12961	19	0	0	0	0	0	0	3	32	0	0	0
7	401	1200	55	0	0	351	47	12005	20	0	0	0	0	0	0	2	35	0	0	0
8	115	782	39	0	0	94	53	6178	8	0	0	1	14	1	14	0	0	0	0	0
9	45	303	19	0	0	38	13	1709	6	0	0	2	11	0	0	0	0	0	0	0
10	57	387	10	0	0	73	13	1551	3	0	0	0	0	0	0	0	0	0	0	0
11	132	897	16	0	0	142	21	2000	5	0	0	0	0	3	10	0	0	0	0	0
12	365	2459	4	0	0	108	30	1877	2	0	0	0	0	0	0	0	0	0	0	0
13	350	2370	7	0	0	48	23	880	0	0	0	0	0	2	5	0	0	0	0	0
14	216	1466	25	0	0	45	5	419	3	0	0	0	0	0	0	0	0	1	1	1
15	49	911	80	0	0	49	8	394	0	0	0	0	0	0	0	0	0	0	0	0
16	22	388	66	0	0	22	3	196	0	0	0	0	0	0	0	0	0	0	0	0
17	27	482	61	0	0	31	3	115	1	0	0	0	0	0	0	0	0	0	0	0
18	27	498	9	3	50	63	12	227	3	0	0	0	0	0	0	0	0	0	0	50
19	6	100	14	2	11	13	4	38	0	0	0	0	0	0	0	0	0	0	0	11
20	2	46	8	2	17	19	2	22	0	0	0	0	0	0	0	0	0	0	0	17
21	4	68	6	17	215	4	1	27	0	0	0	0	0	0	0	0	0	0	0	215
22	8	150	6	41	420	8	0	45	1	0	0	0	0	0	0	0	0	0	0	420
23	2	46	7	25	446	6	1	27	0	0	0	0	0	0	0	0	0	0	0	446
24	2	30	25	32	539	13	4	19	0	0	0	0	0	0	0	0	0	1	21	560
25	3	51	19	87	783	16	3	35	1	0	0	0	0	0	0	0	0	0	0	783
26	1	21	16	79	737	8	2	23	2	0	0	0	0	0	0	0	0	1	12	749
27	2	43	39	68	660	9	0	44	0	0	0	0	0	0	0	0	0	2	25	685
28	4	75	14	149	1297	12	1	20	1	0	0	0	0	0	0	0	0	3	33	1330
29	3	57	4	59	765	4	1	20	2	0	0	0	0	0	0	0	0	6	100	865
30	2	28	0	120	1317	3	0	13	0	0	0	0	0	0	0	0	0	2	28	1345
TOT	4863	21911	923	684	7257	2611	623	82596	147	2	11	3	25	12	107	11	115	16	220	7477

Appendix Table B.26. Lower Bound of 90 percent confidence interval about linear estimate of outmigration for July, 1985.

DAY	USCHK ESTD	UFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	USTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
1	0	45	2	109	1394	5	0	20	1	0	0	0	0	0	0	0	0	9	147	1541
2	0	89	0	207	2006	2	1	19	0	0	0	0	0	0	0	0	0	21	260	2266
3	0	72	4	171	1266	5	0	19	0	0	0	0	0	0	0	0	0	32	303	1569
4	0	41	0	98	1269	0	0	4	0	0	0	0	0	0	0	0	0	8	133	1402
5	0	25	0	121	2478	4	0	4	0	0	0	0	0	0	0	0	0	9	236	2714
6	0	13	0	68	1621	0	3	0	0	0	0	0	0	0	0	0	0	8	244	1865
7	0	20	0	55	1162	0	0	0	0	0	0	0	0	0	0	0	0	6	163	1325
8	0	34	0	47	723	0	0	0	0	0	0	0	0	0	0	0	0	14	276	999
9	0	8	1	22	387	1	0	0	1	0	0	0	0	0	0	0	0	12	270	657
10	0	3	0	25	345	0	0	0	0	0	0	0	0	0	0	0	0	6	107	452
11	0	7	0	47	296	0	0	0	0	0	0	0	0	0	0	0	0	5	40	336
12	0	9	0	18	162	0	0	0	0	0	0	0	0	0	0	0	0	10	115	277
13	0	13	1	6	108	0	0	0	0	0	0	0	0	0	0	0	0	6	139	247
14	0	36	0	5	142	0	0	3	0	0	0	0	0	0	0	0	0	5	185	327
15	0	20	0	6	80	0	0	1	0	0	0	0	0	0	0	0	0	25	428	508
16	0	9	0	16	106	0	0	0	0	0	0	0	0	0	0	0	0	14	120	226
17	0	10	0	8	94	0	0	0	0	0	0	0	0	0	0	0	0	2	29	123
18	0	3	0	3	40	0	0	0	0	0	0	0	0	0	0	0	0	3	52	92
19	0	4	0	7	72	1	0	0	0	0	0	0	0	0	0	0	0	1	13	85
20	0	6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	42
21	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38
22	0	7	0	1	8	0	0	0	0	0	0	0	0	0	0	0	0	5	53	61
23	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	41	41
24	0	5	0	1	17	0	0	0	0	0	0	0	0	0	0	0	0	1	20	37
25	0	6	0	1	7	0	0	0	0	0	0	0	0	0	0	0	0	2	16	23
26	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	34	34
27	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	61	61
28	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	48	48
29	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	22	22
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	18	18
31	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	20	20
TOT	0	516	8	1042	13783	19	4	70	2	0	0	0	0	0	0	0	0	223	3593	17456

Appendix Table B.27. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for March, 1985.

DAY	USCHK ESTD	UFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	USTH ESTD	HSTH ESTD	COHO ESTD	RAIL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
11	8	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	8	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	4	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	14	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	5	0	5	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	10	0	0	0	0	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	12	0	0	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	37	0	7	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	9	0	0	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	20	0	6	0	0	67	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	41	0	3	0	0	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	72	0	19	0	0	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	37	0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	74	0	5	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	50	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	26	0	2	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	9	0	2	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	13	0	4	0	0	48	0	0	0	0	0	2	4	0	0	0	0	0	0	0
TOT	444	0	62	0	0	604	0	0	0	0	0	2	4	0	0	0	0	0	0	0

Appendix Table B.28. Upper Bound of 90 percent **confidence** interval about linear estimate of outmigration for April, 1985.

M Y	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	HSTH ESTD	HSTH ESTD	COHO ESTD	RAIL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK mill	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHORE ESTD
1	14	0	5	0	0	38		0		2	5	0	0	0	0	0				0
2	25	0	10			54	2	0	0	0	0	2	10	0	0	0	00	00	00	0
3	102	0	17	8	00	233	0	0	0	0	0	0	0	2	10	2				0
4	277	0			0	467	2:	0	0	14	142	0	0	0	0	0	00	00	00	0
5	551	0	168	0	0	G59	6	0		5	54	11	114	0	0	0				0
6	786	0	331	0	0	857	0	0	00	13	97	32	234	0	0	0	00	00	00	0
7	811	0			0	577					80	34	154	0	0	0	0	0	0	0
	638	16	228	0	0	441	5	8		5	32	16	96			0	0		0	0
3	712	19	178	8	0	620	30	0	8	255	58	10	120	8	8	0	0	8	0	0
10	3391	84				1000	17		0		198	35	267	0	0	0			0	0
11	1381	34	265	0	8	244	501	00	140	6	119	6	114	0	0	0	00	00	0	0
12	2402	59	513	0	0	957				6	62		437	0	0	0	0	0	0	0
13	2164	54	462	0	0	063	452	0	12	6	56	a:	393	0	0	0	0	0	0	0
14	6125	125	2250	0	0	2875	2375	0	125	0	0	375	2125	0	0	0				0
15	2160	200	400		0	1360	880		0		0	0	0	40	400	0	0	00	00	0
16	2704	373				1196	1020	0	39	8	0	39	333		0	0	0	00	00	
17	2380	329	373	0	8	886	1000	0	13	13	152	25	291	8	0					8
18	2892	392	456	0		490	1049		10	0	0	49	343	0	0	0	0	0	0	
19	619	82	353	0	8	1464				0	0	10	113	0					0	8
20	263	36	139	0	0	1540	1584	0	15	0	0	0	0	0	8	8	8	8	0	0
21	158	19			0	1763	1674	8	6	9	56	9	56	0	0	0		0		0
22	204	8	126	8	0	1303	970			3	25	6	50	3	28	3	17	0	8	0
23	353	15		0	0	1170	1240	8	2:	2	23	11	141	2	27	2	17			0
24	1215	50	210	0	0	874	943			4	66	13	188	0	0	17			0	0
25	1124	47	495	0		027	790	0	17	9	136	9	130	2	42	15	192 170	80	0	0
26	1437	60	412	0	8	770	013	0	21	7	127	8	142	0	0	9		0		0
27	2969	123	1339	0	0	1104	1224	0	54	16	215	38	490	18	266	31	312 123	0	00	0
28	5378	224	3273	0	0	1169	1458	0	280	31	410	70	878	38	529				0	0
29	2693	113	1820	0		868	896	0	196	26	340	26	321	18	240	178	1177	0	0	0
30	2840	119	2230	0	8	1681	1515	0	305	2	25	38	574	22	377	81	722 940	8		0
TOT	40040	2661	17471	0	0	28350	21838	0	1133	226	2478	968	8114	145	1919	362	3685	0	8	0

Appendix Table B.29. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for Hay, 1985.

DAY	WSCHK ESTD	WFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	WSTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHCHK ESTD
1	1731	417	1807		0			0	300	18	200	23		37		76	620		0	0
2	2447	589	1428	8	0	1080	900 714	0	290	13	139	22	242 234	25	448	59	468	8	0	0
3	2743	661	1497	0	0			0	334	5	62	15	178	36	463	53	461	0		0
4	2050	·35	1928	0	0	1069	645 1355		359	8	123		253	39		46	536		8	0
5	2216	533	2349	0	0	1926	1216	8	390	21	271	:a	295	44	657	81	772	8	0	0
6	1828	440	1003	0	0	1646	679	0	328	11	156	17		44	666	41	420		0	0
7	1065	2%	1178	0				0	259	1	15	17	234 186	26	329	45	387	8	0	0
8	908	803	1004	0	8	1146 1205	428	0	235	6	58	27	241	22	221	37	249	0	0	
		.9	750	.				0	195	0	0	9	116	13		28	267	0	0	0
10	1259	1115	850	0	0	980	307	0	198	2	31	11		24	181 320	19	174	0		0
11	811	718	843	0	0	1181	403	0	184	5	56	10	128	22		23	202	0	0	0
12	734	650	1311	0	0	982	315			7	118	9	140	30	202 544	24	298	0	0	0
13	741	6%	551			992	278	8	203 153	2	31	2		10	143	20	194	0	0	0
14	975	864	656	8	8	049	194	8	86	0	0	0	30 0	9	206	15	364	0	0	0
15	543	704	299		0	741	146		56	1	16	0	0	1	135	9	92	0		0
16	634	024	244	8	0	704	178	0	56	0	0	1	25		28	8	134	0	0	0
17	1702	2208	554		0	1057	264	0	130	2	25	7	70	17	181	20	149	0	0	0
18	1955	2538	696	8	0	1764	464	0	680 219	5	66	3	32	70	978 232	16	146	0	0	0
19	1939	2517	2375	0	0	2350	1350			8	103	8	97			55	517	0	0	0
20	1164	1511	2706	0	0	1901	1497	0	663	2	18	22	239	128	1211	89	574	0		0
21	1451	1880	2139		0	1887	1214 1518	0	304	7	106	18	194 297	48		58	607	0	0	0
22	1169	1957	1365	8				0	239	9	101			41	746 495	41	333	0	0	0
23	1223	2047	826					0	115	6	64	4	40	42		21	155	0	0	0
24	1370	2297	555	8	8	990	486	0	144	0	0	2	22	26	452 280	15	110		0	0
25	390	651	241		0	310	300		29	0	0				29	22	183	8	0	0
26	731	1224	391	8	0			0	50	0	0	0	8	13	111	16	230	0	0	0
27	1038	1740	470	0	0	336	282 134	0	136	3	28	0	0	18	175 157	18	149	0	0	0
28	796	1335	202	0	0		81	0	35	0	0	0	0			11	72			0
29	711	1190	212	0	0	327 385	69	59	31	0	0	0	0	19	154	4	26	8	0	0
30	511	856	220	0	0		66	3	20	0	0	3	31	0	106	0	0		0	0
31	924	1549	225	0	0	148	71	7	25	1	32	0	0		0	4	72	8		0
TOT	39280	36054	31765	0	0	32054	16463	69	6526	143	1819	299	3451	839	10848	974	8961	0	0	0

Appendix Table B.30. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for June, 1985.

DAY	USCHK ESTD	UPCHK ESTD	HSCHK ESTD	HPCHK ESTD	HPCHK2 ESTD	USTH ESTD	HSTH ESTD	COHO ESTD	PATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	SHEEK ESTD
1	583	1747	159	0	0	156	75	1857	24	0	0	0	0	3	64	0	0	0	0	0
2	631	1893	77	0	0	233	108	8450	21	0	0	0	0	0	0	4	44	0	0	0
3	479	1438	49	0	0	202	103	10422	12	3	14	0	0	3	15	1	5	0	0	0
4	1140	3419	37	0	0	348	72	18415	8	0	0	0	0	3	16	3	10	0	0	0
5	404	1213	73	0	0	323	61	12098	23	0	0	0	0	0	0	0	0	0	0	0
6	463	1393	62	0	0	491	39	15784	24	0	0	0	0	0	0	4	39	0	0	0
7	487	1458	67	0	0	427	57	14585	24	0	0	0	0	0	0	3	43	0	0	0
8	150	1022	51	0	0	123	70	8079	11	0	0	2	18	2	18	0	0	0	0	0
9	75	502	31	0	0	62	22	2832	9	0	0	3	19	0	0	0	0	0	0	0
10	161	1088	29	0	0	204	36	4358	7	0	0	0	0	0	0	0	0	0	0	0
11	364	2479	43	0	0	393	57	5529	14	0	0	0	0	7	29	0	0	0	0	0
12	644	4337	7	0	0	191	52	3311	4	0	0	0	0	0	0	0	0	0	0	0
13	482	3261	9	0	0	67	32	1211	0	0	0	0	0	2	7	0	0	0	0	0
14	271	1835	31	0	0	57	7	525	3	0	0	0	0	0	0	0	0	2	2	2
15	60	1110	98	0	0	60	10	481	0	0	0	0	0	0	0	0	0	0	0	0
16	26	461	78	0	0	26	4	232	0	0	0	0	0	0	0	0	0	0	0	0
17	31	565	72	0	0	36	4	135	1	0	0	0	0	0	0	0	0	0	0	0
18	31	573	10	3	58	72	14	261	3	0	0	0	0	0	0	0	0	0	0	3
19	7	118	16	2	13	15	5	45	0	0	0	0	0	0	0	0	0	0	0	3
20	2	55	10	2	20	23	2	26	0	0	0	0	0	0	0	0	0	0	0	0
21	5	81	7	20	256	5	1	32	0	0	0	0	0	0	0	0	0	0	0	26
22	9	177	7	48	495	9	0	53	1	0	0	0	0	0	0	0	0	0	0	45
23	2	54	8	29	523	7	1	32	0	0	0	0	0	0	0	0	0	0	0	53
24	2	36	30	38	639	15	5	23	0	0	0	0	0	0	0	0	0	1	25	64
25	4	60	23	103	928	19	4	41	1	0	0	0	0	0	0	0	0	0	0	93
26	1	25	19	93	871	9	2	27	2	0	0	0	0	0	0	0	0	1	14	85
27	2	51	46	80	776	11	0	52	0	0	0	0	0	0	0	0	0	2	29	86
28	5	88	16	175	1526	14	1	24	1	0	0	0	0	0	0	0	0	4	39	155
29	4	67	5	69	895	5	1	23	2	0	0	0	0	0	0	0	0	7	117	102
30	2	33	0	140	1535	3	0	15	0	0	0	0	0	0	0	0	0	2	33	158
TOT	6527	30639	1170	802	8535	3606	845	108958	195	3	14	5	37	20	149	15	141	19	259	879

Appendix Table B.31. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for July, 1985.

DAY	USCHK ESTD	UFCHK ESTD	HSCHK ESTD	HFCHK ESTD	HFCHK2 ESTD	USTH ESTD	HSTH ESTD	COHO ESTD	RATL ESTD	NOV84 ESTD	NOV842 ESTD	SEP84 ESTD	SEP842 ESTD	TRUCK ESTD	TRUCK2 ESTD	POND ESTD	POND2 ESTD	JUN85 ESTD	JUN852 ESTD	[illegible] ESTD
1	0	52	2	127	1619	6	0	23	1	0	0	0	0	0	0	0	0	10	171	1790
2	0	102	0	238	2303	2	1	22	0	0	0	0	0	0	0	0	0	24	299	2602
3	0	83	5	197	1455	6	0	22	0	0	0	0	0	0	0	0	0	37	348	1803
4	0	48	0	114	1477	0	0	5	0	0	0	0	0	0	0	0	0	9	155	1632
5	0	30	0	143	2933	5	0	5	0	0	0	0	0	0	0	0	0	11	279	3212
6	0	15	0	81	1930	0	4	0	0	0	0	0	0	0	0	0	0	10	290	2220
7	0	24	0	65	1382	0	0	0	0	0	0	0	0	0	0	0	0	7	194	1576
8	0	41	0	56	862	0	0	0	0	0	0	0	0	0	0	0	0	17	329	1191
9	0	10	1	26	465	1	0	0	1	0	0	0	0	0	0	0	0	14	325	790
10	0	4	0	31	421	0	0	0	0	0	0	0	0	0	0	0	0	7	131	552
11	0	9	0	58	368	0	0	0	0	0	0	0	0	0	0	0	0	6	50	418
12	0	11	0	23	205	0	0	0	0	0	0	0	0	0	0	0	0	13	145	350
13	0	16	1	8	136	0	0	0	0	0	0	0	0	0	0	0	0	8	176	312
14	0	45	0	6	176	0	0	4	0	0	0	0	0	0	0	0	0	6	230	406
15	0	24	0	7	97	0	0	1	0	0	0	0	0	0	0	0	0	30	519	617
16	0	11	0	19	127	0	0	0	0	0	0	0	0	0	0	0	0	17	144	272
17	0	12	0	10	115	0	0	0	0	0	0	0	0	0	0	0	0	2	35	150
18	0	4	0	4	50	0	0	0	0	0	0	0	0	0	0	0	0	4	65	115
19	0	5	0	9	91	1	0	0	0	0	0	0	0	0	0	0	0	1	17	108
20	0	8	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	53
21	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47
22	0	9	0	1	10	0	0	0	0	0	0	0	0	0	0	0	0	6	65	75
23	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	50	50
24	0	6	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0	1	25	46
25	0	8	0	1	9	0	0	0	0	0	0	0	0	0	0	0	0	3	20	20
26	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	43	43
27	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	77	77
28	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	61	61
29	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	28	28
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	23	23
31	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	25	25
TOT	0	617	9	1225	16252	22	5	82	2	0	0	0	0	0	0	0	0	268	4319	20573

Appendix Table B.32. Outmigration for March, 1984.

[illegible]	[illegible] ([illegible])	[illegible] (EST)	POND (EST)	TRUCK (EST)	[illegible] (EST)	[illegible] (EST)	UPCH[illegible] (EST)	HPCH[illegible] (EST)	JUN84 (EST)
5	19	0	0	0	0	0	0	0	0
6	11	0	0	0	4	0	0	0	0
7	15	0	0	0	3	0	0	0	0
8	11	0	0	0	4	0	0	0	0
9	10	0	0	0	4	0	0	0	0
10	10	0	0	0	4	0	0	0	0
11	11	0	0	0	4	0	0	0	0
12	12	0	0	0	5	0	0	0	0
13	13	0	0	0	5	0	0	0	0
14	11	0	0	0	6	0	0	0	0
15	5	0	0	0	10	0	0	0	0
16	2	0	0	0	15	0	0	0	0
17	15	0	0	0	20	0	0	0	0
18	17	0	0	0	22	0	0	0	0
19	33	0	0	0	33	0	0	0	0
20	13	0	0	0	13	0	0	0	0
21	46	0	0	0	56	0	0	0	0
22	112	0	0	0	124	0	0	0	0
23	269	0	0	0	365	0	0	0	0
24	273	0	[illegible]	0	322	0	0	0	0
25	336	0	0	0	227	0	0	0	0
26	333	0	0	0	227	0	0	0	0
27	124	0	0	0	258	0	0	0	0
28	152	0	0	0	383	0	0	0	0
29	212	0	0	0	265	0	0	0	0
30	252	0	0	0	450	0	0	0	0
31	433	0	0	0	381	0	0	0	0
TOT	2761	0	0	0	3220	0	0	0	0

Appendix Table B.33. Outmigration for April, 1984.

DAY	[illegible] ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	[illegible] ESTD	HSSTH ESTD	[illegible] ESTD	HFCHK ESTD	[illegible] ESTD
1	[illegible]	0	0	0	253	0	0	0	0
2	764	0	0	0	466	0	0	0	0
3	637	0	0	0	176	0	0	0	0
4	1051	0	0	0	369	0	0	0	0
5	1530	0	0	0	377	0	0	0	0
6	1780	0	0	0	307	0	0	0	0
7	1394	0	0	0	364	0	0	0	0
8	1207	0	0	0	320	0	0	0	0
9	1303	0	0	0	449	0	0	0	0
10	[illegible]	0	0	0	325	0	0	0	0
11	1025	0	0	0	382	0	0	0	0
12	819	0	0	0	294	0	0	0	0
13	451	5	0	0	219	0	0	0	0
14	430	0	0	0	338	0	0	0	0
15	554	0	0	0	475	3	0	0	0
16	1614	0	0	0	782	0	0	0	0
17	5617	0	0	0	1491	0	0	0	0
18	2876	51	0	0	1564	15	0	0	0
19	4201	208	39	0	1591	227	0	0	0
20	3550	280	25	6	1590	578	0	0	0
21	2641	215	30	15	1585	502	0	0	0
22	1754	132	[illegible]	2	1330	529	0	0	0
23	2198	238	59	33	1436	867	0	0	0
24	2336	323	133	134	857	651	0	0	0
25	1869	301	101	54	982	508	0	0	0
26	2119	365	102	12	852	514	0	0	0
27	2554	314	37	[illegible]	935	388	0	0	0
28	1572	236	37	[illegible]	803	288	0	0	0
29	1016	287	58	20	600	209	0	0	0
30	1108	365	101	31	1188	360	0	0	0
TOT	51703	3329	751	353	22710	5939	0	0	0

Appendix Table B.34. Outmigration for May, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUV84 ESTD
1	1289	299	42	14	924	286	0	0	0
2	2040	518	82	18	1099	235	0	0	0
3	1854	618	97	17	1169	166	0	0	0
4	2367	802	106	37	2557	420	0	0	0
5	1943	863	120	59	2545	531	0	0	0
6	1369	677	92	42	1701	431	0	0	0
7	707	312	51	26	1054	261	0	0	0
8	585	274	35	24	975	229	122	0	0
9	798	298	41	22	1021	190	168	0	0
10	1069	451	83	48	1229	197	223	0	0
11	660	435	60	54	888	88	137	0	0
12	950	576	74	48	1215	169	198	0	0
13	718	334	62	21	900	169	150	0	0
14	1112	270	36	31	1343	180	232	0	0
15	3180	719	102	135	2555	449	746	0	0
16	4271	1519	176	194	1964	571	1005	0	0
17	4733	1568	199	169	1831	490	1111	0	0
18	4135	1231	46	254	1223	127	969	0	0
19	4195	1276	42	54	1395	73	985	0	0
20	2817	924	76	111	1000	76	660	0	0
21	2485	677	21	81	609	21	626	0	0
22	1735	730	35	130	535	20	1065	0	0
23	1484	577	33	77	582	33	912	0	0
24	1280	286	5	26	799	0	783	0	0
25	951	335	0	29	369	10	587	0	0
26	1277	241	23	32	823	23	786	0	0
27	672	157	4	13	545	9	417	0	0
28	2811	133	4	28	558	20	1727	0	0
29	2225	80	0	14	449	14	1366	0	0
30	4091	251	7	28	672	31	2512	0	0
31	753	68	4	12	199	20	462	0	0
TOT	60556	17499	1758	1848	34728	5539	17949	0	0

Appendix Table B.35. Outmigration for June, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	502	133	5	0	453	20	1137	0	0
2	567	87	0	10	474	5	995	0	0
3	409	30	0	0	401	37	595	0	0
4	529	60	3	9	263	54	900	0	0
5	442	25	0	0	195	20	[illegible]		
[illegible]	[illegible]	[illegible]	0	0					[illegible]
7	247	5	5	0	71	0	423	0	0
8	85	7	0	0	43	0	450	0	0
9	66	7	0	7	66	0	323	0	0
10	106	0	0	0	42	0	535	0	0
11	85	0	0	0	20	0	457	0	0
12	194	0	0	0	42	0	1012	0	0
13	109	0	0	0	31	0	563	0	0
14	279	5	0	0	51	0	1479	0	0
15	333	5	0	0	82	0	1037	0	0
16	86	0	0	0	43	5	274	0	0
17	22	0	0	0	44	0	56	0	0
18	11	0	0	0	0	0	22	0	0
19	53	0	0	0	0	0	171	0	0
20	112	0	0	0	22	22	348	22	0
21	58	0	0	0	19	0	175	0	0
22	30	0	0	0	0	0	110	40	0
23	0	0	0	0	0	0	52	0	0
24	0	0	0	0	0	0	1220	0	0
25	0	0	0	0	0	0	21	21	0
26	0	0	0	0	0	0	21	21	0
27	0	0	0	0	0	0	0	19	0
28	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	27	658	164
30	0	0	0	0	0	0	96	964	458
TOT	4500	393	13	26	2453	170	13699	1745	622

Appendix Table B.36. Outmigration for July, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	0	0	0	0	0	0	116	1053	800
2	0	0	0	0	0	0	250	2652	563
3	0	0	0	0	0	0	218	3113	887
4	0	0	0	0	59	0	140	4297	4505
5	0	0	0	0	22	0	81	2720	1228
6	0	0	0	0	2	0	56	4834	320
7	0	0	0	0	3	0	59	2708	1030
8	0	0	0	0	0	0	120	714	1077
9	0	0	0	0	0	0	66	1394	279
10	0	0	0	0	1	0	79	1227	190
11	0	0	0	0	1	0	64	1196	133
12	0	0	0	0	3	0	20	547	53
13	0	0	0	0	1	0	50	473	158
14	0	0	0	0	0	0	41	453	145
15	0	0	0	0	1	0	51	842	66
16	0	0	0	0	0	0	2	329	14
17	0	0	0	0	0	0	32	321	93
18	0	0	0	0	0	0	62	422	225
19	0	0	0	0	0	0	27	280	356
20	0	0	0	0	0	0	9	206	131
21	0	0	0	0	1	0	27	120	262
22	0	0	0	0	0	0	21	194	26
23	0	0	0	0	0	0	32	192	158
24	0	0	0	0	0	0	11	7	210
25	0	0	0	0	0	0	7	0	134
26	0	0	0	0	0	0	15	76	0
27	0	0	0	0	0	0	11	43	0
28	0	0	0	0	0	0	4	53	0
29	0	0	0	0	0	0	7	18	39
30	0	0	0	0	0	0	0	10	0
31	0	0	0	0	0	0	1	7	0
TOT	0	0	0	0	94	0	1679	30501	1[illegible]082

Appendix Table B.37. Linear estimate of outmigration for March, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
5	14	0	0	0	0	0	0	0	0
6	10	0	0	0	3	0	0	0	0
7	15	0	0	0	3	0	0	0	0
8	11	0	0	0	4	0	0	0	0
9	10	0	0	0	4	0	0	0	0
10	10	0	0	0	4	0	0	0	0
11	11	0	0	0	4	0	0	0	0
12	12	0	0	0	5	0	0	0	0
13	12	0	0	0	5	0	0	0	0
14	10	0	0	0	5	0	0	0	0
15	5	0	0	0	10	0	0	0	0
16	2	0	0	0	14	0	0	0	0
17	14	0	0	0	19	0	0	0	0
18	15	0	0	0	20	0	0	0	0
19	29	0	0	0	29	0	0	0	0
20	11	0	0	0	11	0	0	0	0
21	40	0	0	0	48	0	0	0	0
22	92	0	0	0	103	0	0	0	0
23	205	0	0	0	277	0	0	0	0
24	192	0	0	0	227	0	0	0	0
25	238	0	0	0	160	0	0	0	0
26	236	0	0	0	161	0	0	0	0
27	89	0	0	0	192	0	0	0	0
28	117	0	0	0	277	0	0	0	0
29	157	0	0	0	197	0	0	0	0
30	195	0	0	0	348	0	0	0	0
31	349	0	0	0	308	0	0	0	0
TOT	2101	0	0	0	2438	0	0	0	0

Appendix Table B.38. Linear estimate of outmigration for April, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	540	0	0	0	221	0	0	0	0
2	668	0	0	0	408	0	0	0	0
3	584	0	0	0	161	0	0	0	0
4	1007	0	0	0	353	0	0	0	0
5	1527	0	0	0	376	0	0	0	0
6	1828	0	0	0	316	0	0	0	0
7	1458	0	0	0	381	0	0	0	0
8	1281	0	0	0	340	0	0	0	0
9	1399	0	0	0	482	0	0	0	0
10	1176	0	0	0	353	0	0	0	0
11	1120	0	0	0	417	0	0	0	0
12	900	0	0	0	322	0	0	0	0
13	508	5	0	0	241	0	0	0	0
14	477	0	0	0	375	0	0	0	0
15	618	0	0	0	531	3	0	0	0
16	1805	0	0	0	874	0	0	0	0
17	6204	0	0	0	1647	0	0	0	0
18	3108	56	0	0	1690	16	0	0	0
19	4405	218	41	0	1669	238	0	0	0
20	3691	291	26	6	1653	705	0	0	0
21	2774	226	31	16	1665	632	0	0	0
22	1867	140	9	2	1416	670	0	0	0
23	2361	256	74	57	1543	931	0	0	0
24	2540	351	144	146	932	708	0	0	0
25	2059	332	112	71	1082	560	0	0	0
26	2357	406	114	14	948	571	0	0	0
27	2853	350	41	9	1044	434	0	0	0
28	1745	262	41	8	891	320	0	0	0
29	1113	314	74	22	657	229	0	0	0
30	1202	396	109	33	1289	391	0	0	0
TOT	55175	3603	816	384	24277	6408	0	0	0

Appendix Table B.39. Linear estimate of outmigration for May, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	1384	321	45	15	992	307	0	0	0
2	2200	558	89	19	1185	253	0	0	0
3	2023	674	105	19	1275	182	0	0	0
4	2617	887	117	41	2827	464	0	0	0
5	2171	964	134	65	2844	593	0	0	0
6	1525	754	103	46	1896	480	0	0	0
7	782	345	57	29	1166	289	0	0	0
8	637	299	38	26	1062	249	132	0	0
9	848	317	43	23	1085	202	179	0	0
10	1116	470	86	50	1283	206	233	0	0
11	684	451	62	56	921	91	142	0	0
12	989	600	77	50	1265	176	207	0	0
13	760	353	65	22	953	179	158	0	0
14	1180	286	39	33	1424	190	246	0	0
15	3276	740	105	139	2632	463	769	0	0
16	4022	1431	165	182	1849	538	946	0	0
17	4037	1337	170	144	1562	418	948	0	0
18	3359	1000	38	206	994	103	788	0	0
19	3411	1037	34	44	1134	59	801	0	0
20	2292	752	62	90	814	62	537	0	0
21	1973	537	17	64	483	17	497	0	0
22	1314	553	27	98	405	15	807	0	0
23	1089	423	24	56	427	24	669	0	0
24	949	212	4	20	592	0	580	0	0
25	721	254	0	22	279	7	445	0	0
26	986	186	18	25	635	18	607	0	0
27	528	124	3	10	428	7	328	0	0
28	2251	106	3	23	447	16	1383	0	0
29	1849	66	0	12	373	12	1136	0	0
30	3443	211	6	23	566	26	2114	0	0
31	616	55	3	10	163	16	378	0	0
TOT	55032	16303	1739	1662	33961	5662	15030	0	0

Appendix Table B.40. Linear estimate of outmigration for June, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	385	102	4	0	347	15	909	0	0
2	444	66	0	8	359	4	753	0	0
3	344	25	0	0	338	31	584	0	0
4	481	55	3	8	239	49	818	0	0
5	402	23	0	0	178	18	686	0	0
6	131	25	0	0	78	6	224	0	0
7	187	4	4	0	54	0	320	0	0
8	61	5	0	0	30	0	318	0	0
9	46	5	0	5	46	0	232	0	0
10	75	0	0	0	30	0	378	0	0
11	61	0	0	0	14	0	325	0	0
12	140	0	0	0	31	0	729	0	0
13	82	0	0	0	23	0	420	0	0
14	215	4	0	0	39	0	1140	0	0
15	257	4	0	0	63	0	799	0	0
16	65	0	0	0	32	4	206	0	0
17	16	0	0	0	32	0	48	0	0
18	8	0	0	0	0	0	15	0	0
19	38	0	0	0	0	0	124	0	0
20	81	0	0	0	16	16	252	16	0
21	42	0	0	0	14	0	125	0	0
22	21	0	0	0	0	0	85	28	0
23	0	0	0	0	0	0	44	0	0
24	0	0	0	0	0	0	857	0	0
25	0	0	0	0	0	0	14	14	0
26	0	0	0	0	0	0	14	14	0
27	0	0	0	0	0	0	0	13	0
28	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	20	475	119
30	0	0	0	0	0	0	71	708	336
TOT	3582	318	11	21	1963	143	10510	1268	455

Appendix Table B.41. Linear estimate of outmigration for July, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	0	0	0	0	0	0	85	769	585
2	0	0	0	0	0	0	179	1904	404
3	0	0	0	0	0	0	157	2244	640
4	0	0	0	0	47	0	113	3469	3636
5	0	0	0	0	20	0	76	2575	1163
6	0	0	0	0	2	0	59	5082	337
7	0	0	0	0	3	0	64	2943	1120
8	0	0	0	0	0	0	126	750	1131
9	0	0	0	0	0	0	66	1385	277
10	0	0	0	0	1	0	76	1174	181
11	0	0	0	0	1	0	61	1133	126
12	0	0	0	0	3	0	19	522	51
13	0	0	0	0	1	0	48	454	152
14	0	0	0	0	0	0	39	434	139
15	0	0	0	0	1	0	49	805	63
16	0	0	0	0	0	0	2	314	13
17	0	0	0	0	0	0	31	307	89
18	0	0	0	0	0	0	59	404	215
19	0	0	0	0	0	0	26	269	342
20	0	0	0	0	0	0	9	198	126
21	0	0	0	0	1	0	26	116	253
22	0	0	0	0	0	0	20	187	25
23	0	0	0	0	0	0	31	185	152
24	0	0	0	0	0	0	11	7	202
25	0	0	0	0	0	0	7	0	129
26	0	0	0	0	0	0	14	73	0
27	0	0	0	0	0	0	11	41	0
28	0	0	0	0	0	0	4	51	0
29	0	0	0	0	0	0	7	17	38
30	0	0	0	0	0	0	0	10	0
31	0	0	0	0	0	0	1	7	0
TOT	0	0	0	0	80	0	1476	27829	11589

Appendix Table B.42. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for March, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
5	34	0	0	0	0	0	0	0	0
6	15	0	0	0	5	0	0	0	0
7	20	0	0	0	3	0	0	0	0
8	13	0	0	0	5	0	0	0	0
9	12	0	0	0	5	0	0	0	0
10	12	0	0	0	5	0	0	0	0
11	13	0	0	0	5	0	0	0	0
12	14	0	0	0	6	0	0	0	0
13	16	0	0	0	6	0	0	0	0
14	13	0	0	0	7	0	0	0	0
15	6	0	0	0	13	0	0	0	0
16	3	0	0	0	18	0	0	0	0
17	18	0	0	0	24	0	0	0	0
18	20	0	0	0	27	0	0	0	0
19	40	0	0	0	40	0	0	0	0
20	15	0	0	0	15	0	0	0	0
21	56	0	0	0	68	0	0	0	0
22	154	0	0	0	171	0	0	0	0
23	523	0	0	0	709	0	0	0	0
24	1179	0	0	0	1393	0	0	0	0
25	1103	0	0	0	744	0	0	0	0
26	770	0	0	0	525	0	0	0	0
27	238	0	0	0	513	0	0	0	0
28	270	0	0	0	640	0	0	0	0
29	310	0	0	0	388	0	0	0	0
30	337	0	0	0	601	0	0	0	0
31	545	0	0	0	480	0	0	0	0
TOT	5749	0	0	0	6416	0	0	0	0

Appendix Table B.43. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for April, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	785	0	0	0	322	0	0	0	0
2	921	0	0	0	562	0	0	0	0
3	766	0	0	0	211	0	0	0	0
4	1270	0	0	0	446	0	0	0	0
5	1861	0	0	0	458	0	0	0	0
6	2181	0	0	0	377	0	0	0	0
7	1715	0	0	0	448	0	0	0	0
8	1491	0	0	0	396	0	0	0	0
9	1614	0	0	0	557	0	0	0	0
10	1343	0	0	0	404	0	0	0	0
11	1277	0	0	0	476	0	0	0	0
12	1022	0	0	0	366	0	0	0	0
13	574	6	0	0	273	0	0	0	0
14	536	0	0	0	421	0	0	0	0
15	689	0	0	0	592	3	0	0	0
16	2010	0	0	0	974	0	0	0	0
17	6980	0	0	0	1853	0	0	0	0
18	3561	64	0	0	1936	18	0	0	0
19	5172	256	43	0	1959	279	0	0	0
20	4360	344	31	7	1953	833	0	0	0
21	3256	265	37	18	1954	742	0	0	0
22	2167	163	11	2	1543	778	0	0	0
23	2724	295	85	66	1780	1075	0	0	0
24	2902	401	165	167	1065	809	0	0	0
25	2322	374	126	80	1220	631	0	0	0
26	2629	453	127	15	1058	637	0	0	0
27	3162	388	45	10	1157	481	0	0	0
28	1934	290	45	9	987	354	0	0	0
29	1233	348	82	24	728	254	0	0	0
30	1330	438	121	37	1427	432	0	0	0
TOT	63787	4085	923	435	28003	7326	0	0	0

Appendix Table B.44. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for May, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	1534	356	50	17	1100	341	0	0	0
2	2438	619	98	21	1313	281	0	0	0
3	2244	748	117	21	1415	201	0	0	0
4	2908	986	130	46	3141	516	0	0	0
5	2411	1071	149	73	3158	658	0	0	0
6	1689	835	114	51	2099	532	0	0	0
7	865	382	63	32	1291	320	0	0	0
8	705	331	42	29	1176	276	147	0	0
9	942	352	48	26	1205	225	199	0	0
10	1242	524	96	55	1428	229	259	0	0
11	761	502	69	62	1025	101	158	0	0
12	1101	667	86	56	1407	196	230	0	0
13	849	395	73	25	1064	200	177	0	0
14	1339	325	44	37	1617	216	279	0	0
15	3904	882	125	165	3137	552	916	0	0
16	5198	1849	214	236	2390	695	1223	0	0
17	5789	1917	244	207	2240	599	1360	0	0
18	5144	1531	57	316	1522	158	1206	0	0
19	5214	1586	52	67	1733	90	1224	0	0
20	3481	1142	94	137	1236	94	815	0	0
21	3227	878	28	105	790	28	812	0	0
22	2444	1028	49	183	754	28	1500	0	0
23	2231	868	50	116	876	50	1372	0	0
24	1862	415	8	38	1162	0	1138	0	0
25	1307	460	0	40	507	13	807	0	0
26	1683	317	30	42	1084	30	1036	0	0
27	859	201	5	16	696	11	533	0	0
28	3535	167	5	35	702	25	2172	0	0
29	2741	98	0	18	554	18	1683	0	0
30	4996	306	9	34	821	38	3068	0	0
31	974	88	5	15	258	26	598	0	0
TOT	75617	21826	2154	2321	42901	6747	22913	0	0

Appendix Table B.45. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for June, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	718	190	7	0	648	28	1697	0	0
2	852	126	0	15	689	7	1444	0	0
3	526	38	0	0	517	48	895	0	0
4	642	73	3	10	319	66	1094	0	0
5	536	31	0	0	237	24	914	0	0
6	200	38	0	0	119	10	343	0	0
7	398	9	9	0	115	0	681	0	0
8	200	17	0	0	100	0	1050	0	0
9	164	18	0	18	164	0	818	0	0
10	238	0	0	0	95	0	1206	0	0
11	169	0	0	0	39	0	896	0	0
12	330	0	0	0	72	0	1722	0	0
13	159	0	0	0	45	0	818	0	0
14	375	6	0	0	69	0	1988	0	0
15	442	6	0	0	109	0	1376	0	0
16	131	0	0	0	66	8	418	0	0
17	31	0	0	0	61	0	92	0	0
18	12	0	0	0	0	0	24	0	0
19	38	0	0	0	0	0	124	0	0
20	135	0	0	0	27	27	419	27	0
21	130	0	0	0	43	0	391	0	0
22	68	0	0	0	0	0	273	91	0
23	0	0	0	0	0	0	77	0	0
24	0	0	0	0	0	0	857	0	0
25	0	0	0	0	0	0	14	14	0
26	0	0	0	0	0	0	14	14	0
27	0	0	0	0	0	0	0	13	0
28	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	20	475	119
30	0	0	0	0	0	0	71	708	336
TOT	6494	552	19	43	3534	218	19736	1342	455

Appendix Table B.46. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for July, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	0	0	0	0	0	0	138	1250	950
2	0	0	0	0	0	0	467	4950	1050
3	0	0	0	0	0	0	525	7492	2136
4	0	0	0	0	84	0	201	6195	6494
5	0	0	0	0	27	0	102	3431	1549
6	0	0	0	0	2	0	69	5967	395
7	0	0	0	0	3	0	72	3299	1255
8	0	0	0	0	0	0	140	836	1261
9	0	0	0	0	0	0	74	1555	312
10	0	0	0	0	1	0	86	1337	207
11	0	0	0	0	1	0	71	1313	146
12	0	0	0	0	4	0	22	618	60
13	0	0	0	0	1	0	58	545	182
14	0	0	0	0	0	0	47	520	166
15	0	0	0	0	1	0	58	955	75
16	0	0	0	0	0	0	2	371	15
17	0	0	0	0	0	0	37	363	105
18	0	0	0	0	0	0	70	482	256
19	0	0	0	0	0	0	31	325	413
20	0	0	0	0	0	0	11	243	155
21	0	0	0	0	1	0	32	144	314
22	0	0	0	0	0	0	25	231	31
23	0	0	0	0	0	0	38	227	186
24	0	0	0	0	0	0	13	9	246
25	0	0	0	0	0	0	9	0	157
26	0	0	0	0	0	0	17	89	0
27	0	0	0	0	0	0	14	51	0
28	0	0	0	0	0	0	5	64	0
29	0	0	0	0	0	0	9	21	48
30	0	0	0	0	0	0	0	13	0
31	0	0	0	0	0	0	1	9	0
TOT	0	0	0	0	125	0	2444	42905	18164

Appendix Table B.47. Lower Bound of 90 percent confidence interval about linear estimate of outmigration for March, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
5	9	0	0	0	0	0	0	0	0
6	7	0	0	0	2	0	0	0	0
7	12	0	0	0	2	0	0	0	0
8	9	0	0	0	4	0	0	0	0
9	9	0	0	0	4	0	0	0	0
10	9	0	0	0	4	0	0	0	0
11	9	0	0	0	4	0	0	0	0
12	10	0	0	0	4	0	0	0	0
13	10	0	0	0	4	0	0	0	0
14	8	0	0	0	4	0	0	0	0
15	4	0	0	0	8	0	0	0	0
16	2	0	0	0	12	0	0	0	0
17	12	0	0	0	16	0	0	0	0
18	12	0	0	0	16	0	0	0	0
19	23	0	0	0	23	0	0	0	0
20	9	0	0	0	9	0	0	0	0
21	31	0	0	0	37	0	0	0	0
22	66	0	0	0	73	0	0	0	0
23	127	0	0	0	173	0	0	0	0
24	104	0	0	0	123	0	0	0	0
25	133	0	0	0	90	0	0	0	0
26	139	0	0	0	95	0	0	0	0
27	54	0	0	0	117	0	0	0	0
28	75	0	0	0	177	0	0	0	0
29	106	0	0	0	132	0	0	0	0
30	137	0	0	0	244	0	0	0	0
31	257	0	0	0	226	0	0	0	0
TOT	1383	0	0	0	1603	0	0	0	0

Appendix Table B.48. Lower Bound of 90 percent confidence interval about linear estimate of outmigration for April, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	410	0	0	0	168	0	0	0	0
2	526	0	0	0	321	0	0	0	0
3	472	0	0	0	130	0	0	0	0
4	836	0	0	0	293	0	0	0	0
5	1295	0	0	0	319	0	0	0	0
6	1573	0	0	0	272	0	0	0	0
7	1268	0	0	0	331	0	0	0	0
8	1122	0	0	0	298	0	0	0	0
9	1235	0	0	0	426	0	0	0	0
10	1046	0	0	0	314	0	0	0	0
11	998	0	0	0	372	0	0	0	0
12	806	0	0	0	289	0	0	0	0
13	455	5	0	0	216	0	0	0	0
14	430	0	0	0	338	0	0	0	0
15	560	0	0	0	481	3	0	0	0
16	1635	0	0	0	792	0	0	0	0
17	5584	0	0	0	1482	0	0	0	0
18	2752	49	0	0	1497	14	0	0	0
19	3844	190	36	0	1456	207	0	0	0
20	3206	253	22	5	1436	612	0	0	0
21	2421	197	27	14	1453	552	0	0	0
22	1637	123	8	2	1241	587	0	0	0
23	2083	225	65	51	1361	822	0	0	0
24	2258	312	128	130	829	629	0	0	0
25	1852	298	100	64	973	504	0	0	0
26	2139	368	103	12	861	519	0	0	0
27	2598	319	37	8	951	395	0	0	0
28	1592	239	37	8	813	292	0	0	0
29	1015	287	68	20	599	209	0	0	0
30	1095	361	100	30	1174	356	0	0	0
TOT	48743	3226	731	344	21486	5701	0	0	0

Appendix Table B.49. Lower Bound of 90 percent confidence interval about linear estimate of outmigration for May, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	1262	293	41	14	905	280	0	0	0
2	2005	509	81	17	1080	231	0	0	0
3	1843	614	96	17	1162	165	0	0	0
4	2382	808	107	38	2573	423	0	0	0
5	1974	877	122	59	2586	539	0	0	0
6	1389	686	94	42	1726	437	0	0	0
7	714	315	52	26	1064	264	0	0	0
8	580	272	35	24	967	227	121	0	0
9	771	288	39	21	987	184	163	0	0
10	1013	427	78	45	1164	187	211	0	0
11	621	409	56	51	835	82	129	0	0
12	898	544	70	46	1148	160	187	0	0
13	688	320	59	20	863	162	143	0	0
14	1054	256	35	29	1272	170	220	0	0
15	2826	639	90	120	2271	399	663	0	0
16	3286	1169	135	149	1511	439	773	0	0
17	3106	1029	131	111	1202	322	729	0	0
18	2500	744	28	153	740	77	586	0	0
19	2541	773	26	32	845	44	596	0	0
20	1708	560	46	67	606	46	400	0	0
21	1417	386	12	46	347	12	357	0	0
22	897	377	18	67	276	10	550	0	0
23	722	281	16	37	283	16	444	0	0
24	637	142	3	13	397	0	389	0	0
25	499	176	0	15	193	5	308	0	0
26	697	132	12	17	449	12	429	0	0
27	382	89	2	7	309	5	237	0	0
28	1655	78	2	17	329	12	1017	0	0
29	1395	50	0	9	282	9	857	0	0
30	2626	161	4	18	432	20	1613	0	0
31	449	40	2	7	119	12	276	0	0
TOT	44537	13444	1492	1334	28923	4951	11398	0	0

Appendix Table B.50. Lower Bound of 90 percent confidence interval about linear estimate of outmigration for June, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	263	70	3	0	237	10	621	0	0
2	300	44	0	5	243	3	509	0	0
3	255	19	0	0	251	23	434	0	0
4	384	44	2	6	191	39	654	0	0
5	322	19	0	0	142	14	548	0	0
6	97	19	0	0	58	5	167	0	0
7	122	3	3	0	35	0	208	0	0
8	36	3	0	0	18	0	188	0	0
9	27	3	0	3	27	0	135	0	0
10	44	0	0	0	18	0	224	0	0
11	37	0	0	0	9	0	199	0	0
12	89	0	0	0	19	0	464	0	0
13	55	0	0	0	16	0	283	0	0
14	150	3	0	0	28	0	797	0	0
15	182	2	0	0	45	0	565	0	0
16	43	0	0	0	21	3	136	0	0
17	9	0	0	0	18	0	27	0	0
18	3	0	0	0	0	0	7	0	0
19	15	0	0	0	0	0	48	0	0
20	35	0	0	0	7	7	110	7	0
21	20	0	0	0	7	0	61	0	0
22	10	0	0	0	0	0	41	14	0
23	0	0	0	0	0	0	18	0	0
24	0	0	0	0	0	0	277	0	0
25	0	0	0	0	0	0	4	4	0
26	0	0	0	0	0	0	4	4	0
27	0	0	0	0	0	0	0	4	0
28	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	7	179	45
30	0	0	0	0	0	0	29	292	139
TOT	2498	229	8	14	1390	104	6765	504	184

Appendix Table B.51. Lower Bound of 90 percent confidence interval about linear estimate of outmigration for July, 1984.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD	HFCHK ESTD	JUN84 ESTD
1	0	0	0	0	0	0	39	351	267
2	0	0	0	0	0	0	92	974	207
3	0	0	0	0	0	0	92	1315	375
4	0	0	0	0	33	0	78	2409	2525
5	0	0	0	0	16	0	61	2061	931
6	0	0	0	0	2	0	51	4425	293
7	0	0	0	0	3	0	58	2656	1011
8	0	0	0	0	0	0	115	687	1036
9	0	0	0	0	0	0	62	1312	263
10	0	0	0	0	1	0	74	1146	177
11	0	0	0	0	1	0	61	1133	126
12	0	0	0	0	3	0	19	522	51
13	0	0	0	0	1	0	48	454	152
14	0	0	0	0	0	0	39	434	139
15	0	0	0	0	1	0	49	805	63
16	0	0	0	0	0	0	2	314	13
17	0	0	0	0	0	0	31	307	89
18	0	0	0	0	0	0	59	404	215
19	0	0	0	0	0	0	26	269	342
20	0	0	0	0	0	0	9	198	126
21	0	0	0	0	1	0	26	116	253
22	0	0	0	0	0	0	20	187	25
23	0	0	0	0	0	0	31	185	152
24	0	0	0	0	0	0	11	7	202
25	0	0	0	0	0	0	7	0	129
26	0	0	0	0	0	0	14	73	0
27	0	0	0	0	0	0	11	41	0
28	0	0	0	0	0	0	4	51	0
29	0	0	0	0	0	0	7	17	38
30	0	0	0	0	0	0	0	10	0
31	0	0	0	0	0	0	1	7	0
TOT	0	0	0	0	62	0	1197	22870	9200

Appendix Table B.52. Outmigration for April, 1983.

WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
634	0	0	0	366	0	0
1112	0	0	0	704	0	0
2050	0	0	0	866	0	0
3020	0	0	0	564	0	0
763	0	0	0	161	0	0
925	0	0	0	219	0	0
837	0	0	0	210	0	0
992	0	0	0	253	0	0
612	0	0	0	267	0	0
756	0	0	0	266	0	0
1127	0	0	0	289	0	0
2628	0	0	0	358	8	0
5241	0	0	0	420	40	0
3715	0	0	0	445	19	0
3282	0	0	0	682	3	0
9178	0	0	0	979	143	63
4733	0	0	0	1229	108	13
6741	0	0	0	1508	0	5
7636	0	0	0	1318	20	0
6698	111	0	0	1802	63	0
5843	243	0	0	1670	191	113
4789	532	28	9	2459	64	128
3389	722	19	9	1546	65	56
3025	483	25	8	1534	203	186
3248	1030	30	0	1256	248	504
2935	1948	144	33	1242	307	229
4802	4737	347	96	2060	365	790
90751	9806	593	155	24673	1847	2087

Appendix Table B.53. Outmigration for May, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
1	3718	7052	379	92	1626	264	1052
2	3432	11216	623	142	1840	438	2099
3	3362	8732	584	134	1926	872	3087
4	2364	5245	413	133	1448	552	2259
5	3227	6647	313	160	147	613	253
6	1650	4236	257	43	1193	264	793
7	2416	4560	168	80	1448	408	1768
8	1722	3269	148	83	1241	611	2463
9	1156	1697	64	73	963	294	1110
10	975	1342	17	8	975	208	1067
11	1129	1554	50	43	1094	295	1317
12	1145	1915	42	61	727	733	1915
13	1654	2473	49	68	780	976	3210
14	1417	2286	20	83	1377	258	3155
15	911	1790	24	100	1282	189	2032
16	670	1426	19	35	1183	276	1843
17	1074	1234	15	27	1098	251	1296
18	1021	1016	5	49	917	169	2078
19	631	791	5	19	784	179	1746
20	606	839	9	18	819	216	2397
21	1324	851	12	44	1349	259	3054
22	1260	1385	24	51	1701	442	2352
23	1182	1275	28	36	1692	551	2215
24	671	491	0	23	1064	249	1578
25	830	422	0	0	762	116	1129
26	458	176	0	0	267	46	977
27	274	111	0	0	214	60	1162
28	272	136	0	0	311	58	1505
29	478	65	0	0	272	33	1533
30	571	39	0	0	169	26	2026
31	234	47	0	0	172	0	1750
TOT	41834	74318	3268	1605	30841	9906	56271

Appendix Table B.54. Outmigration for June, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
1	357	54	0	0	214	0	1857
2	216	20	0	0	98	20	1863
3	118	98	0	0	78	0	1490
4	228	35	18	0	105	0	1474
5	217	14	0	0	29	14	1594
6	443	0	0	0	57	0	2955
7	139	0	0	0	120	19	981
8	206	0	0	0	142	0	1844
9	153	23	0	0	73	0	2305
10	142	9	0	0	71	5	1481
11	53	0	0	0	61	13	329
12	70	5	0	0	89	5	551
13	81	0	0	0	96	0	409
14	77	5	0	0	93	0	881
15	29	12	0	0	98	8	1049
16	114	6	0	0	60	11	1840
17	57	2	0	0	39	2	1267
18	104	3	0	0	32	5	1519
19	17	4	1	0	10	3	653
20	30	2	1	0	26	2	792
21	19	0	0	0	23	1	528
22	7	0	0	0	16	0	292
23	12	0	0	0	2	0	342
24	17	0	0	0	6	1	406
25	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0
27	10	0	0	0	4	0	282
28	29	0	0	0	5	0	436
29	8	0	0	0	2	0	118
30	0	0	0	0	0	0	0
TOT	2953	292	20	0	1649	109	29538

Appendix Table B.55. Outmigration for July, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	UFCHK ESTD
1	0	0	0	0	2	0	197
2	0	0	0	0	6	0	349
3	0	0	0	0	0	0	39
4	0	0	0	0	0	0	0
5	0	0	0	0	1	0	126
6	0	0	0	0	0	0	61
7	0	0	0	0	0	0	140
8	0	0	0	0	0	0	37
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	43
12	0	0	0	0	1	0	54
13	0	0	0	0	0	0	65
14	0	0	0	0	0	0	89
15	0	0	0	0	0	0	17
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	27
21	0	0	0	0	0	0	18
22	0	0	0	0	0	0	18
23	0	0	0	0	0	0	18
24	0	0	0	0	0	0	18
25	0	0	0	0	0	0	18
26	0	0	0	0	0	0	18
27	0	0	0	0	0	0	10
28	0	0	0	0	0	0	4
29	0	0	0	0	0	0	7
30	0	0	0	0	0	0	7
31	0	0	0	0	0	0	7
TOT	0	0	0	0	10	0	1392

Appendix Table B.56. Linear estimate of outmigration for April, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
4	447	0	0	0	258	0	0
5	797	0	0	0	505	0	0
6	1510	0	0	0	638	0	0
7	2290	0	0	0	428	0	0
8	592	0	0	0	125	0	0
9	720	0	0	0	171	0	0
10	701	0	0	0	166	0	0
11	802	0	0	0	204	0	0
12	512	0	0	0	223	0	0
13	663	0	0	0	233	0	0
14	1013	0	0	0	260	0	0
15	2425	0	0	0	331	7	0
16	4851	0	0	0	389	37	0
17	3396	0	0	0	407	18	0
18	2903	0	0	0	603	3	0
19	7721	0	0	0	824	121	53
20	3774	0	0	0	980	86	10
21	5102	0	0	0	1141	0	4
22	5490	0	0	0	948	14	0
23	4742	79	0	0	1275	45	0
24	4148	173	0	0	1185	136	80
25	3390	377	19	6	1740	45	91
26	2408	513	13	7	1099	46	39
27	2151	343	18	6	1090	145	133
28	2310	733	21	0	893	176	358
29	2098	1393	103	23	888	220	164
30	3472	3424	251	69	1489	264	571
TOT	70428	7035	425	111	18493	1363	1503

Appendix Table B. 57. Linear estimate of outmigration for May, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
1	2718	5155	277	67	1189	193	769
2	2471	8076	449	102	1324	316	1511
3	2397	6225	416	96	1373	622	2201
4	1673	3713	292	94	1025	391	1599
5	2294	4725	223	114	104	436	180
6	1173	3010	183	30	848	188	563
7	1726	3257	120	57	1034	291	1263
8	1232	2338	106	60	887	437	1762
9	818	1201	45	52	682	208	786
10	688	947	12	6	688	147	753
11	801	1102	36	31	776	209	934
12	833	1392	31	44	529	533	1392
13	1265	1892	37	52	597	746	2455
14	1148	1852	16	68	1116	209	2556
15	770	1515	20	84	1084	160	1762
16	581	1236	17	31	1025	239	1597
17	958	1100	13	24	979	224	1156
18	956	951	5	46	859	158	1946
19	612	767	5	18	760	174	1694
20	592	821	9	18	800	211	2343
21	1269	815	12	42	1292	248	2925
22	1131	1244	21	46	1523	397	2113
23	973	1050	23	30	1393	453	1823
24	492	360	0	17	780	182	1157
25	589	300	0	0	541	82	802
26	324	124	0	0	189	32	692
27	194	79	0	0	152	42	824
28	194	97	0	0	222	42	1076
29	349	48	0	0	198	24	1119
30	411	28	0	0	121	19	1458
31	165	33	0	0	121	0	1231
TOT	31797	55453	2368	1229	24216	7613	44442

Appendix Table B.58. Linear estimate of outmigration for June, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
1	247	37	0	0	148	0	1284
2	149	14	0	0	68	14	1284
3	80	67	0	0	53	0	1013
4	159	24	12	0	73	0	1024
5	156	10	0	0	21	10	1146
6	322	0	0	0	41	0	2149
7	100	0	0	0	87	13	707
8	148	0	0	0	102	0	1327
9	113	17	0	0	55	0	1714
10	108	7	0	0	54	4	1134
11	41	0	0	0	48	10	257
12	54	4	0	0	68	4	423
13	61	0	0	0	72	0	308
14	58	4	0	0	69	0	660
15	23	10	0	0	79	7	848
16	105	5	0	0	55	10	1686
17	59	2	0	0	40	2	1303
18	113	3	0	0	34	5	1656
19	19	4	1	0	12	3	725
20	33	3	1	0	29	3	876
21	21	0	0	0	25	1	575
22	7	0	0	0	17	0	306
23	12	0	0	0	2	0	340
24	16	0	0	0	6	1	387
25	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0
27	10	0	0	0	4	0	280
28	30	0	0	0	5	0	447
29	8	0	0	0	2	0	124
30	0	0	0	0	0	0	0
TOT	2252	211	14	0	1269	87	23983

Appendix Table B.59. Linear estimate of outmigration for July, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
1	0	0	0	0	3	0	212
2	0	0	0	0	7	0	384
3	0	0	0	0	0	0	44
4	0	0	0	0	0	0	0
5	0	0	0	0	2	0	141
6	0	0	0	0	0	0	69
7	0	0	0	0	0	0	156
8	0	0	0	0	0	0	41
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	51
12	0	0	0	0	1	0	56
13	0	0	0	0	0	0	67
14	0	0	0	0	0	0	90
15	0	0	0	0	0	0	18
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	27
21	0	0	0	0	0	0	18
22	0	0	0	0	0	0	18
23	0	0	0	0	0	0	18
24	0	0	0	0	0	0	18
25	0	0	0	0	0	0	18
26	0	0	0	0	0	0	18
27	0	0	0	0	0	0	10
28	0	0	0	0	0	0	5
29	0	0	0	0	0	0	7
30	0	0	0	0	0	0	7
31	0	0	0	0	0	0	7
TOT	0	0	0	0	13	0	1500

Appendix Table B. 60. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for April, 1983.

DAY	[illegible] ESTD	[illegible] ESTD	[illegible] ESTD	TRUCK ESTD	[illegible] ESTD	[illegible] ESTD	[illegible] ESTD
4	1700	0	0	0	980	0	0
5	2194	0	0	0	1389	0	0
6	3191	0	0	0	1347	0	0
7	4162	0	0	0	777	0	0
8	1000	0	0	0	210	0	0
9	1198	0	0	0	284	0	0
10	1128	0	0	0	267	0	0
11	1242	0	0	0	316	0	0
12	751	0	0	0	327	0	0
13	916	0	0	0	321	0	0
14	1354	0	0	0	347	0	0
15	3155	0	0	0	430	9	0
16	6302	0	0	0	504	48	0
17	4453	0	0	0	533	23	0
18	3952	0	0	0	821	3	0
19	11217	0	0	0	1196	175	76
20	6107	0	0	0	1586	139	16
21	10007	0	0	0	2238	0	7
22	15581	0	0	0	2689	40	0
23	24114	400	0	0	6485	228	0
24	41999	1749	0	0	11999	1374	612
25	9400	1054	54	18	4872	127	254
26	6905	1471	37	18	3150	132	113
27	5028	802	42	14	2549	338	309
28	9391	2978	86	0	3630	717	1456
29	5512	3725	275	62	2375	587	437
30	8020	7910	580	160	3440	610	1320
TOT	190169	20089	1074	272	55062	4550	4800

Appendix Table B.61. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for May, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
1	5881	11154	600	145	2572	418	1663
2	5978	19537	1086	247	3204	763	3655
3	6770	17581	1175	270	3878	1756	6216
4	5200	11538	907	292	3184	1215	4969
5	6368	13118	618	315	289	1210	500
6	3982	10224	620	103	2879	637	1913
7	3728	7037	259	123	2234	629	2728
8	3647	6921	313	176	2627	1294	5215
9	2290	3363	127	145	1909	581	2200
10	4875	6708	83	41	4875	1041	5333
11	2754	3789	122	105	2666	719	3210
12	1989	3326	73	105	1263	1273	3326
13	2321	3472	68	95	1095	1369	4506
14	1803	2909	25	106	1752	328	4015
15	1108	2179	29	121	1560	230	2535
16	806	1718	23	42	1424	332	2220
17	1291	1483	17	32	1320	302	1558
18	1231	1225	6	59	1106	203	2507
19	763	957	5	22	948	216	2113
20	733	1016	11	22	991	261	2902
21	1597	1026	14	52	1626	311	3682
22	1551	1705	29	62	2095	544	2897
23	1578	1702	37	48	2259	735	2956
24	1084	794	0	37	1719	401	2551
25	1742	885	0	0	1600	242	2371
26	1363	522	0	0	795	136	2909
27	470	191	0	0	367	102	1999
28	297	148	0	0	340	63	1648
29	349	47	0	0	196	23	1119
30	411	28	0	0	121	16	1457
31	164	32	0	0	120	0	1230
TOT	74124	136335	6247	2765	53016	17352	88103

Appendix Table B.62. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for June, 1983.

DAY	MSCHK ESTD	MSCHT ESTD	POLD ESTD	TRUCK ESTD	USTH ESTD	USTL ESTD	UPCHK ESTD
1	245	37	0	0	148	0	1263
2	148	15	0	0	57	13	1283
3	60	66	0	0	53	0	1013
4	153	24	12	0	73	0	1024
5	156	10	0	0	20	10	1145
6	341	0	0	0	62	0	3611
7	283	0	0	0	245	37	1999
8	508	0	0	0	350	0	4561
9	245	35	0	0	118	0	3709
10	191	12	0	0	95	5	1999
11	[illegible]	0	0	0	80	17	428
12	94	5	0	0	119	5	742
13	114	0	0	0	135	0	578
14	110	7	0	0	132	0	1257
15	37	15	0	0	127	10	1361
16	141	7	0	0	74	14	2275
17	70	3	0	0	46	2	1561
18	123	3	0	0	38	5	1673
19	20	4	1	0	12	3	604
20	35	0	1	0	31	3	369
21	15	0	0	0	27	1	337
22	6	[illegible]	0	0	16	0	340
23	15	0	0	0	2	0	380
24	13	0	0	0	6	1	437
25	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0
27	10	0	0	0	4	0	313
28	33	0	0	0	5	0	499
29	[illegible]	0	0	0	2	0	137
30	0	0	0	0	0	0	0
SUM	3360	245	14	0	2098	128	33216

Appendix Table B. 63. Upper Bound of 90 percent confidence interval about linear estimate of outmigration for July, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
1	0	0	0	0	2	0	235
2	0	0	0	0	7	0	425
3	0	0	0	0	0	0	48
4	0	0	0	0	0	0	0
5	0	0	0	0	1	0	136
6	0	0	0	0	0	0	76
7	0	0	0	0	0	0	173
8	0	0	0	0	0	0	45
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	56
12	0	0	0	0	1	0	62
13	0	0	0	0	0	0	74
14	0	0	0	0	0	0	101
15	0	0	0	0	0	0	20
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	30
21	0	0	0	0	0	0	20
22	0	0	0	0	0	0	20
23	0	0	0	0	0	0	20
24	0	0	0	0	0	0	20
25	0	0	0	0	0	0	20
26	0	0	0	0	0	0	20
27	0	0	0	0	0	0	11
28	0	0	0	0	0	0	5
29	0	0	0	0	0	0	7
30	0	0	0	0	0	0	7
31	0	0	0	0	0	0	7
TOT	0	0	0	0	11	0	1658

Appendix Table B. 64. Lower Bound of 90 percent confidence interval about linear estimate of outmigration for April, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POLD ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
4	258	0	0	0	148	0	0
5	487	0	0	0	308	0	0
6	989	0	0	0	418	0	0
7	1575	0	0	0	294	0	0
8	421	0	0	0	89	0	0
9	516	0	0	0	122	0	0
10	507	0	0	0	120	0	0
11	591	0	0	0	151	0	0
12	368	0	0	0	169	0	0
13	519	0	0	0	182	0	0
14	809	0	0	0	207	0	0
15	1966	0	0	0	268	6	0
16	3336	0	0	0	315	30	0
17	2739	0	0	0	328	14	0
18	2294	0	0	0	477	2	0
19	5885	0	0	0	628	92	40
20	2731	0	0	0	709	63	7
21	3424	0	0	0	766	0	3
22	3342	0	0	0	577	9	0
23	2629	44	0	0	707	25	0
24	2175	91	0	0	621	71	42
25	1723	191	10	3	884	23	46
26	1216	259	7	3	555	23	20
27	1144	183	10	3	580	77	71
28	1317	418	12	0	509	101	204
29	1287	854	63	14	544	135	100
30	2222	2191	161	44	953	169	366
TOT	47091	4231	263	67	11629	840	899

Appendix Table B. 65. Lower Bound of 90 percent confidence interval about linear estimate of outmigration for May, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
1	1763	3343	180	44	771	125	499
2	1557	5090	283	64	835	199	952
3	1452	3771	252	58	832	377	1333
4	997	2212	174	56	611	233	953
5	1395	2873	135	69	63	265	110
6	690	1770	107	18	499	110	331
7	947	1787	66	31	567	160	693
8	618	1173	53	30	445	219	884
9	416	611	23	26	347	106	399
10	371	511	6	3	371	79	406
11	469	645	21	18	454	122	546
12	528	883	20	28	335	338	883
13	869	1300	26	36	410	513	1687
14	844	1362	12	50	820	154	1879
15	589	1158	16	64	829	122	1347
16	452	963	13	24	799	186	1245
17	761	874	10	19	778	178	918
18	781	777	4	38	702	129	1590
19	510	640	4	15	634	145	1413
20	497	689	8	15	672	177	1968
21	1050	675	10	35	1070	205	2422
22	892	981	17	36	1205	313	1666
23	702	757	17	22	1005	327	1315
24	317	232	0	11	503	117	746
25	356	181	0	0	327	50	484
26	184	71	0	0	107	18	393
27	103	42	0	0	80	23	437
28	95	47	0	0	108	20	525
29	155	21	0	0	88	11	498
30	162	11	0	0	48	7	576
31	57	11	0	0	42	0	426
TOT	20579	35461	1457	810	16357	5028	29524

Appendix Table B.66. Lower Bound of 90 percent confidence interval about linear estimate of outmigration for June, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
1	78	12	0	0	47	0	403
2	43	4	0	0	20	4	373
3	23	20	0	0	16	0	297
4	50	8	4	0	23	0	324
5	57	4	0	0	8	4	415
6	139	0	0	0	18	0	925
7	50	0	0	0	43	7	353
8	87	0	0	0	60	0	776
9	74	11	0	0	35	0	1112
10	76	5	0	0	38	3	791
11	29	0	0	0	34	7	183
12	38	3	0	0	48	3	296
13	41	0	0	0	49	0	210
14	39	3	0	0	47	0	446
15	17	7	0	0	58	5	614
16	83	4	0	0	44	8	1339
17	50	2	0	0	35	2	1120
18	101	3	0	0	31	4	1483
19	17	4	1	0	11	3	659
20	30	3	1	0	26	3	799
21	19	0	0	0	23	1	524
22	7	0	0	0	16	0	280
23	11	0	0	0	2	0	320
24	16	0	0	0	6	1	377
25	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0
27	9	0	0	0	4	0	261
28	28	0	0	0	4	0	413
29	9	0	0	0	2	0	112
30	0	0	0	0	0	0	0
TOT	1220	93	6	0	748	55	15205

Appendix Table B. 67 Lower Bound of 90 percent confidence interval about linear estimate of outmigration for July, 1983.

DAY	WSCHK ESTD	HSCHK ESTD	POND ESTD	TRUCK ESTD	WSTH ESTD	HSTH ESTD	WFCHK ESTD
1	0	0	0	0	2	0	193
2	0	0	0	0	6	0	350
3	0	0	0	0	0	0	40
4	0	0	0	0	0	0	0
5	0	0	0	0	1	0	128
6	0	0	0	0	0	0	62
7	0	0	0	0	0	0	142
8	0	0	0	0	0	0	37
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	46
12	0	0	0	0	1	0	51
13	0	0	0	0	0	0	61
14	0	0	0	0	0	0	82
15	0	0	0	0	0	0	16
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	25
21	0	0	0	0	0	0	17
22	0	0	0	0	0	0	16
23	0	0	0	0	0	0	17
24	0	0	0	0	0	0	17
25	0	0	0	0	0	0	17
26	0	0	0	0	0	0	17
27	0	0	0	0	0	0	9
28	0	0	0	0	0	0	4
29	0	0	0	0	0	0	6
30	0	0	0	0	0	0	6
31	0	0	0	0	0	0	6
TOT	0	0	0	0	10	0	1365

Appendix C

Prosser Smolt Trap Efficiency Tests and Passage Data

Appendix Table C.1. Daily captures of spring chinook, hatchery chinook and steelhead at Wapatox trap for for April, 1985.

Date	Spring chinook wild	Spring chinook hatchery	Steelhead
040185	23	-	0
040285	NC*	NC	NC
040385	474	-	13
040485	1,167	-	22
040585	851	-	21
040685	534	-	7
040785	902	-	8
040885	661	-	11
040985	627	351	12
041085	828	443	33
041185	286	1	5
041285	197	89	5
041385	135	61	12
041485	152	41	17
041585	228	45	6
041685	71	11	5
041785	114	0	56
041885	NC	NC	NC
041985	170	96	53
042085	147	80	25
042185	19	3	5
042285	NC	NC	NC
042385	59	58	142
042485	145	87	103
042585	62	35	25
042685	57	10	6
042785	NC	NC	NC
042885	418	151	17
042985	40	0	34
043085	27	54	15

* - Trap was not checked on this day.

Appendix Table C.2. Daily captures of spring chinook, hatchery chinook and steelhead at Wapatox trap for May, 1985.

Date	Spring chinook wild	Spring chinook hatchery	Steelhead
050185	11	**36**	13
050285	17	38	24
050385	104	202	12
050485	NC*	NC	NC
0505115	22	144	17
050685	1	10	0
050/85	16	1/	9
050885	NC	NC	NC
050985	31	3/	9
051085	NC	NC	NC
051185	NC	NC	NC
051285	NC	NC	NC
051385	36	105	79
051485	27	133	22
051585	NC	NC	NC
051685	80	0	9
051/85	26	35	43
051885	NC	NC	NC
051985	NC	NC	NC
052085	NC	NC	NC
052185	5	26	1
052285	NC	NC	NC
052385	NC	NC	NC
052485	8	13	0
052585	NC	NC	NC
052685	NC	NC	NC
052/85	NC	NC	NC
052885	NC	NC	NC
052985	0	3	1
053085	NC	NC	NC
053185	1	4	8

* - Trap not checked on this day.

Appenaix Table C.3. Daily captures of spring chinook, hatchery chinook and steelhead at Wapatox trap for June, 1985.

Date	Spring chinook wild	Spring chinook hatchery	Steelhead
060185	NC*	NC	NC
060285	NC	NC	NC
060385	NC	NC	NC
060485	9	6	52
060585	2	7	19
060685	0	2	3
060/86	NC	NC	NC
060885	NC	NC	NC
060985	NC	NC	NC
061085	NC	NC	NC
061185	NC	NC	NC
061285	NC	NC	NC
061385	NC	NC	NC
061485	NC	NC	NC
061585	3	9	24
061685	NC	NC	NC
061/85	NC	NC	NC
061885	1	3	8
061985	NC	NC	NC
062085	6	0	0
062185	NC	NC	NC
062285	8	6	4
062385	NC	NC	NC
062485	10	2	7
062585	NC	NC	NC
062685	9	2	8
062185	NC**	NC	NC
062885	TI	TI	TI
062985	TI	TI	TL
063085	TI	TI	TI

* - Trap not checked on this day.
**- Trap was not checked on this day.

Appendix Table C.5. **Daily** captures of **spring chinook,** hatchery **chinook** and steelhead at Wapatox trap for August, 1985.

Date	Spring chinook wild	Spring chinook hatchery	Steelhead
080185	NC*	NC	NC
080285	NC	NC	NC
080385	NC	NC	NC
080485	26	0	3
080585	NC	NC	NC
080685	103	0	2
080785	78	0	3
080885	NC	NC	NC
080985	NC	NC	NC
081085	NC	NC	NC
081185	NC	NC	NC
081285	NC	NC	NC
081385	338	0	22
081485	87	0	1
081585	NC	NC	NC
081685	35	0	10
081185	61	0	5
081885	**TI****	TI	TI
081985	TI	TI	TI
082085	TI	TI	**TI**
082185	NC	NC	NC
082285	NC	NC	NC
082385	49	0	6
082485	26	0	5
082585	34	0	9
082685	NC	NC	NC
082185	27	0	4
082885	8	0	0
082985	25	0	2
083085	15	0	8
083185	NC	NC	NC

*- Trap was not checked on **this** day.
**- Trap was inoperable.

Appendix Table C.6. Daily captures of spring chinook, hatchery chinook and steelhead at Wapatox trap for September, 1985.

Date	Spring chinook wild	Spring chinook hatchery	Steelhead
090185	43	0	21
090285	NC*	NC	NC
090385	7	0	4
090485	16	0	5
090585	29	0	5
090685	11	0	3
090785	NC	NC	NC
090885	NC	NC	NC
090985	95	0	9
091085	NC	NC	NC
091185	NC	NC	NC
091285	NC	NC	NC
091385	206	0	45
091485	376	0	49
091585	NC	NC	NC
091685	82	0	8
091785	NC	NC	NC
091885	NC	NC	NC
091985	NC	NC	NC
092085	NC	NC	NC
092185	NC	NC	NC
092285	130	0	10
092385	178	0	0
092485	NC	NC	NC
092585	NC	NC	NC
092685	NC	NC	NC
092785	108	0	3
092885	NC	NC	NC
092985	NC	NC	NC
093085	NC	NC	NC

* Trap not checked on this day.

Appendix Table C.7. Daily captures of spring chinook, hatchery chinook and steelhead at Wapatox trap for October, 1985.

Date	Spring chinook wild	Spring chinook hatchery	Steelhead
100185	58	0	3
100285	NC*	NC	NC
100385	65	0	15
100485	109	0	19
100585	NC	NC	NC
100685	NC	NC	NC
100785	111	0	20
100885	112	0	20
100985	NC	NC	NC
101085	337	0	40
101185	106	0	11
101285	388	0	20
101385	19	0	4
101485	220	0	36
101585	15	0	3
101685	291	0	47
101785	562	0	0
101885	236	0	18
101985	192	0	4
102085	71	0	2
102185	51	0	4
102285	23	0	3
102385	50	0	1
102485	1,851	0	131
102505	2,090	0	69
102685	6,265	0	51
102785	1,760	0	2Y
102885	2,002	0	374
102985	1,865	0	207
103085	446	0	7
103185	456	0	61

* Trap not checked on this day.

Appendix Table C.8. Daily captures of spring chinook, hatchery chinook and steelhead at Wapatox trap for November, 1985.

Date	Spring chinook wild	Spring chinook hatchery	Steelhead
110185	325	0	78
110285	NC*	NC	NC
110385	1,800	0	40
110485	626	0	6
110585	660	0	12
110685	731	0	16
110185	TI**	TI	TI
110885	TI	TI	TI
110985	NC	NC	NC
111085	533	0	7

* - Trap not checked on this day.
**- Trap was inoperable.

Appendix D

Adult Counts At Prosser and Roza Dams

Appendix Table D.1. Total 1985 raw daily raw fish counts for Prosser Dam (Page 1 of 8).

DATE	CHIN ADULT	CHIN JACK	CHIN TOTAL	STHD	COHO
101	0	0	0	0	0
102	0	0	0	0	0
103	0	0	0	0	0
104	0	0	0	0	0
105	0	0	0	0	0
106	0	0	0	0	0
107	0	0	0	0	0
108	0	0	0	0	0
109	0	0	0	0	0
110	0	0	0	0	0
111	0	0	0	0	0
112	0	0	0	0	0
113	0	0	0	0	0
114	0	0	0	1	0
115	0	0	0	0	0
116	0	0	0	0	0
117	0	0		0	0
118	0	0	8	1	0
119	0	0	0	0	0
120	0	0	0	0	0
121	0	0		0	0
122	0	0	8	0	0
123	0	0	0	1	0
124	0	0	0	4	0
125	0	0	0	2	0
126	0	0	0	11	0
127	0	0	0	7	0
128	0	0	0	6	0
129	0	0		2	0
130	0	0	8	0	0
131	0	0	0	7	0
201	0	0	0	0	0
202	0	0		2	0
203	0	0	8	0	0
204	0	0	0	0	0
205	0	0	0	0	0
206	0	0	0		0
207	0	0	0	8	0
208	0	0	0	0	0
209	0	0	0	0	0
210	0	0			0
211	0	0	8	8	0
212	0	0	0	1	0
213	0	0	0	0	0
214	0	0	0	0	0
215	0	0	0	12	0
216	0	0		13	0
217	0	0	8	26	0
218	0	0	0	21	0

Appendix Table D.l. Total 1985 raw daily fish counts for Prosser Dam (Pane 2 of **8)**

DATE	CHIN ADULT	CHIN JACK	CHIN TOTAL	STHD	COHO
219	0	0		17	0
220	0	0	8	12	0
221	0	0		41	0
222	0	0	8	9	0
223	0	0		46	0
224	0	0	8	10	0
225	0	0	0	18	0
226	0	0	0	36	0
227	0	0	0	41	0
228	0	0		18	0
301	0	0	8	15	0
302	0	0	0	22	0
303	0	0		22	0
304	0	0	8	9	0
305	0	0	0	6	0
306	0	0		1	0
307	0	0	8	3	0
308	0	0		9	0
309	0	0	8	3	0
310	0	0	0	2	0
311				8	0
312	8	8	8	9	0
313				4	0
314	8	8	8	1	0
315				1	0
316	8	8	8	2	0
317			0	2	0
318	8	8	0	4	0
319		0		4	0
320	8	0	8	2	0
321		0	0	0	0
322	8	0	0	2	0
323			0	1	0
324	8	8	0	0	0
325			0	0	0
326	8	8		0	0
327			8	1	0
328	8	8	0	1	0
329	0		0	0	0
330	0	8	0		0
331	0	0	0	8	0
401		0	0	2	0
402	8	0	0	0	0
403	0	0	0	0	0
404	0	0	0	0	0
405		0	0	6	0
406	8		0	0	0
407		8	0	0	0
408	8	0	0	0	0

Appendix Table D.1. Total 1985 raw daily fish counts for Prosser Dam (Page 3 of 8).

DATE	CHIN ADULT	CHIN JACK	CHIN TOTAL	STHD	COHO
409	0	0	0	0	
410	0	0	0	1	8
411	0	0	0	0	0
412	0	0	0	3	0
413	0	0	0	0	0
414	0	0	0	0	0
415	0	0	0	1	0
416	0	0	0	1	
417	0	0	0	0	8
418	0	0	0	0	0
419	0	0	0	0	0
420	0	0	0	0	0
421	0	0	0	0	0
422	0	0	0	0	
423	3	0	3	0	8
424	4	0	4	0	
425	1	0	1	0	8
426	6	0	6	0	0
427	10	0	10	0	0
428	6		6	0	0
429	6		6	1	0
430	9	1	10	0	
501	34	0	34	1	8
502	49		49	0	0
503	46		46	0	0
504	44	8	44	1	0
505	14	1		0	0
506	70	0	:a	0	
507	53	1	56	1	8
508	54	1	55		0
509	86			8	0
510	39	0	39		0
511	30	1	31	8	0
512	71		71		0
513	78	8	78	8	0
514	80	1	81		0
515	118	3	121	8	0
516	120	1	121		
517	40	4	41	8	8
518	161	0	165	0	0
519	150		150	0	0
520	118	13	124	0	
521	112	20	125	0	8
522	146			0	0
523	134	13	166	0	0
524	171	14	147	0	0
525	101	4	105	0	0
526	69		73	0	0
527	84	19	103	0	0

Appendix Table D.1. Total 1985 raw daily fish counts for Prosser Dam (Pane 4 of 8).

DATE	CHIN ADULT	CHIN JACK	CHIN TOTAL	STHD	COHO
528	116	25	141	0	
529	135	11	146	0	8
530	201	16	217	0	
531	41	10	51	0	8
601	55	12	67	0	0
602	225	63	288	0	0
603	63	20	83	0	
604	106	30	136	0	8
605	93	21	114	1	
606	47	1	48	0	8
607	21	9	30	0	
608	40	3	43	1	8
609	55	24	79	2	0
610	24	3	27	0	0
611	16	3	19	0	0
612	35	6	41	0	0
613	30	8	38	0	0
614	20	3	23	1	0
615		0	2	0	0
616	13	8	21	0	0
617	19	9	28	0	0
618	7	5	12		0
619		1	11	8	
620	'8	2	8	0	8
621	15	0	15	0	0
622	10	3	13	0	0
623	7	0	7	0	0
624	7	1	8	1	0
625	6	0	6	0	0
626	8	1	9		0
627	5	1	6	8	0
628	6	1	7	0	0
629	4	1		0	0
630	7	1	ii	0	0
701	3	5	8	0	0
702	2	1	3		0
703	1	1	2	8	0
704	2		2	0	0
705	0	8	0	0	0
706	1	0	1	0	0
707		0	0	1	0
708	8	0		0	0
709	0	0	8	0	0
710	2		2	0	0
711	0	8	0	0	
712		0		0	8
713	8	0	8	0	0
714		0		0	0
715	8	0	8	0	0

Appendix Table D.l. Total 1985 raw daily fish counts for Prosser Dam (Page 5 of 8).

DATE	CHIN ADULT	CHIN JACK	CHIN TOTAL	STHD	COHO
716	0	0	0	0	0
717	0	0	0	0	0
718	0	0	0	0	0
719	0	0	0	0	0
720		0	0	0	0
721	8	0	0	0	0
722	0	0	0	0	0
723	0	0	0	0	0
724	0	0	0	0	0
725	0		0	0	0
726	0	8	0	0	0
727	0	0	0	0	0
728	0	0	0	0	0
729	0		0	0	0
730	0	8	0	0	0
731	0	0	0	0	0
801	0	0	0	0	0
802	0	0	0	1	0
803	0	0	0	2	0
804	0	0	0	3	0
805			0	0	0
806	8	8	0	0	0
807	2	0	2	0	0
808	0	0	0	0	0
809			0	0	0
810	8	8	0	0	0
811	0	0	0	0	0
812	0	0	0	0	0
813	1	0	1	2	0
814	2	0	2	2	0
815	0		0	1	0
816	0	8	0	0	0
817	0		0	0	0
818	1	8	1	0	0
819	0		0	0	0
820	3	8	3	1	0
821			0	1	0
822	8	8	0	0	0
823		0	0	0	0
824	8	0	0	0	0
825		0	0	0	0
826	8	0	0	0	0
827	0	0	0	0	0
828	0	0	0	1	0
829		0	0	0	0
830	8		0	0	0
831	0	8	0	0	0
901	0	0	0	0	0
902	0	0	0	0	0

Appendix Table D.1. Total 1985 raw daily fish counts for Prosser Dam (Page 6 of 8).

DATE	CHIN ADULT	CHIN JACK	CHIN TOTAL	STHD	COHO
903	5	0	5	1	0
904	3	3	6	0	0
905	1		1	0	0
906	14	8	14	3	0
907	7	0	7	2	0
908	16	0	16	8	0
909	8	0	8	10	0
910	8	1	9	7	0
911	4	2	6	2	0
912	10	51	61	12	0
913	0	0	0	5	0
914	--	--	--		--
915	2	5	7	a	0
916	4	0	4	28	0
917	1	0	1	3	0
918	3	3	6	19	0
919	0	0	0	13	0
920	0		0	31	0
921	6	8	6	46	0
922	6		6	52	0
923	0	8	0	4	0
924	0	2	2	11	0
925	1	0	1	5	1
926	0		0	1	1
927	7	8		11	0
928	7		lb	23	0
929		3	8	10	0
930	3	0	3	18	0
1001	1	0	1	2	0
1002	0	0	0	4	0
1003	1	1	2	21	5
1004	5	2	7	10	0
1005	2		4	6	0
1006	4	2	8	25	1
1007	1		1	3	0
1008	3	8	3	5	1
1009	--	--	--	--	--
1010	0	0	0		0
1011	1	0	1		1
1012	1	1	2	5	1
1013	1	1	2	4	2
1014	2	0	2	3	0
1015	0	0	0	17	0
1016	0	1	1	7	0
1017	6	0	6	8	1
1018	6	0	6	7	2
1019	4	4	8	19	0
1020	3	2	5	18	3
1021	0	0	0	6	0

Appendix Table D.1. Total 1985 raw daily fish counts for Prosser Dam (Page 7 of 8).

DATE	CHIN ADULT	CHIN JACK	CHIN TOTAL	STHD	COHO
1022	0	0	0	15	1
1023	0	1	1	7	3
1024	4	0	4	9	2
1025	1	0		14	0
1026	7	0	4	9	2
1027	0	1	1	20	3
1028	0	0	0		1
1029	0	0	0	2:	0
1030	1	0	1	1	0
1031	0	0	0	7	0
1101	1	0	1	1	0
1102	0	0	0	6	0
1103	0	0	0	6	0
1104	0	2	2	19	0
1105	0	0	0	36	3
1106	0	0	0	36	2
1107	--	--	- -	--	--
1108	2	0	2	10	0
1109	0	0	0		
1110	0	0		3	8
1111	0			2	
1112	0	8	I	0	8
1113	1	0	1	2	
1114	0	0	0	0	8
1115	0		0	0	
1116	0	8	0	0	8
1117	0		0	0	0
1118	0	8	0	0	0
1119	0	0	0	0	
1120	0	0	0	0	8
1121	0				
1122	0	8	8	8	8
1123	0	0		0	0
1124	0	0	8	0	0
1125	0			0	0
1126	0	8	8	0	0
1127	0			0	0
1128	0	8	8	0	0
1129	0	0		0	0
1130	0	0	8	0	0
1201	0	0	0	0	0
1202	0	0	0	0	0
1203	0	0	0	0	0
1204	0	0	0	0	0
1205	0	0		0	0
1206	0		8	0	0
1207	0	8	0	0	0
1208	0	0	0	0	0
1209	0	0	0	0	0

Appendix Table D.l. Total 1985 raw daily fish counts for Prosser Dam (Page 8 of 8).

DATE	CHIN ADULT	CHIN JACK	CHIN TOTAL	STHD	COHO
1210					0
1211	8	8	8	8	0
1212				0	
1213	0	8	0	0	8
1214	0		0	0	0
1215	0	00	0	0 0	0

Appendix Table D.1. Total 1985 raw daily fish counts for Roza Dam (Page 1 of 3).

DAY NO.	DATE	CHIN ADULT	CHIN JACK	CHIN TOTAL	STHD	AD-CLIPS
14	514	0	0	0	0	0
15	515	0		0	0	0
16	516	0	8	0	0	0
17	517	1	1	2	1	0
18	518	29	0	29	0	1
19	519	47	1	48	1	0
20	520	39	1	40	0	0
21	521	120	0	120	2	0
22	522	--	--	--	--	--
23	523	70	0	70	0	6
24	524	17	0	17	0	1
25	525	67	1	68	0	4
26	526	10	0	10		0
27	527	31	2	33	8	0
28	528	27	0	27	0	3
29	529	58	0	58	0	2
30	530	57	1	58	1	1
	531	68	0	68	0	2
3:	601	79	2	81		1
	602	10	0	10	8	0
32	603	37	1	38		
35	604	67	1	68	8	8
36	605	60	3	63	0	0
37	606	59	3	62	0	3
38	607	52	8	60	0	5
39	608	64	7	71	0	2
40	609	29	1	30		0
41	610	51	1	52	8	1
42	611	61	5	66	0	1
43	612	54	2	56	0	2
44	613	41		48	0	1
45	614	54	a	60	0	2
46	615	65	10	75		3
47	616	29	2	31	8	2
48	617	21	6	27		0
49	618	17	8	25	8	0
50	619	107	27	134		3
51	620	52	10	62	8	1
52	621	44	11	55		0
53	622	43	5	48	8	2
54	623	18	6	24	0	0
55	624	9	3	12		1
56	625	4	0	4	8	0
57	626	14	1	15	0	1
58	627	18	7	25	0	1
59	628	12	5	17	0	0
60	629	6	8	14	0	0
61	630	--	--	--	--	--
62	701	7	2	9	0	0

Appendix Table D.l. Total 1985 raw fish counts for Rota Dam (Page 2 of 3).

DAY NO.	DATE	CHIN ADULT	CHIN JACK	CHIN TOTAL	STHD	AD-CLIPS
63	702	6	2	8	0	1
64	703	8	7	15	0	0
65	704	7	4	11	0	
66	705	11	5	16	0	8
67	706	8	7	15	0	0
68	707	1	1	2	0	0
69	708	9	1	10		0
70	709	28	4	32	8	2
71	710	2	0	2	0	0
72	711	16	6	22		1
73	712	15	5	20	8	0
74	713	9	3	12	0	0
75	714	1	0	1	0	0
76	715	7	2	9	0	0
77	716	5	0	5	0	0
78	717	4	2	6	0	0
79	718	--	--	--	--	--
80	719	3	0	3		
81	720	4	0	4	8	8
82	721	--	--	--	--	--
83	722	6	1	7	0	0
84	723	10	2	12	0	2
85	724	9	2	11	0	0
86	725	14	1	15	0	
87	726	9	5	14	0	8
88	727	10	2	12	0	1
89	728	2	0	2	0	0
90	729	7	0	7	0	2
91	730	11	2	13	0	0
92	731	7	2	9		0
93	801	9	2	11	8	1
94	802	5	1	6	0	0
95	803	6	2	8	0	
96	804	1	0	1	0	8
97	805	0	0		0	0
98	806	0	0	8	0	0
99	807	4	0	4	0	
100	808	5	0	5	0	8
101	809		0	3	0	0
102	810	3		7	0	1
103	811	2	8	2	0	
104	812	1	0	1	0	8
105	813	1	0	1	0	0
106	814	0	0	0	0	0
107	815	0	0	0	0	
108	816	2	0	2	0	8
109	817	2	0	2	0	0
110	818	2	0	2	0	0
111	819	0	0	0	0	0

Appendix Table D. 1. Total 1985 raw daily fish counts for Rota Dam (Page 3 of 3).

DAY NO.	DATE	CHIN ADULT	CHIN JACK	CHIN TOTAL	STHD	AD-CLIPS
112	820	0		0	0	0
113	821	0	8	0	0	0
114	822	1	0	1	1	0
115	823	2	0	2	0	0
116	824	3	0	3	0	1
117	825	0	0	0	0	0
118	826		0	0	0	0
119	827			0	0	0
120	828	I	8	0	0	0
121	829	0	0	0	1	0
122	830	0	0	0	0	0
123	831	1		3	0	0
124	901	0	8	0	1	0
125	902					
126	903	0	0	0	0	0
127	904	1	0	1	0	0
128	905	0	0	0	0	0
129	906	1		1	0	0
130	907	2	8	2	0	
131	908	0	0	0	0	8
132	909	1	0	1	0	0
133	910	0	0	0	0	0
134	911	2	0	2	0	0
135	912	0	0	0	0	0
136	913	0	0	0		0
137	914	0	0	0	8	0
138	915	0	0	0	0	0
139	916	0	0	0	0	0
140	917			0		
141	918		8	0	8	8
142	919	I	0	0	0	
143	920	4	0	4	0	8
144	921	0	0	0	0	0
145	922	0		0	0	0
146	923	0	8	0	0	
147	924	3	1	4	0	
148		0	0	0	0	I
149	926					
150	927	0	0	0	0	0
151	928	0	0	0	0	0
152	929	0	0	0	0	0
153	930	0	0	0	0	0